Nature

A WEEKLY

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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BRUNSWICK STREET, STAMFORD STREET, S.E.,
AND BUNGAY, SUFFOLK.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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THURSDAY, MARCH 5, 1914.

RADIO-ACTIVE ELEMENTS AND THE PERIODIC TABLE.

The Chemistry of the Radio-Elements. Part ii. The Radio-Elements and the Periodic Law. By F. Soddy. Pp. v+46. (London: Longmans, Green and Co., 1914.) Price 2*s.* net.

MR. SODDY'S contention that there exist sets of elements, incapable of separation from each other by chemical means, has much experimental evidence to support it, taken from the behaviour of some of the radio-active elements. At first sight, the argument against such a statement would appear to be similar to one applicable to the "rare elements" of the earth series, lanthanum and its congeners, viz., that the methods of separation have not yet been found. But a little consideration must show this to be untenable. It is possible to apply electroscopic tests to the radio-active elements capable of estimating their amount with an accuracy of, say, 1 per cent. Suppose, then, that a certain process of separation is applied to a mixture of three elements, one of which is radio-active; and suppose that no diminution or increase is noticed in the relative amount of the radio-active element in either portion, it is legitimate to conclude that the radio-active element is inseparable from that element by the process used. By varying the process, if no separation is still effected, it appears a legitimate conclusion that separation by a chemical process is impossible. This, of course, does not exclude separation by a physical process, supposing the atomic weights of the "inseparable" elements to differ; for it is always possible to imagine the elements in a state of gas; and it is undeniable that a mixture of gases could be separated by diffusion into its constituents, provided the gases possess different densities.

In this volume Mr. Soddy gives a diagram showing the position of the elements of high atomic weight; on the assumption that when a radio-active element loses an atom of helium, weighing 4, it joins a group of inseparable elements. Thus, to take an example:—Radium F, of atomic weight 210, in losing an atom of helium, forms a variety of lead of atomic weight 206; similarly thorium C, of atomic weight 212, gives another element which passes as lead, inseparable from lead, of atomic weight 208; similarly radium C, of atomic weight 214, in losing an atom of helium, yields radium D, of atomic weight 210, inseparable from lead. But this is not all; in the β ray changes, the element shifts its position by one place in the opposite direction to that caused by the loss of an α particle, without perceptibly changing its atomic weight; thus thorium D, losing a β corpuscle, or electron, shifts to another group—the lead group—from the thallium group to which it actually belonged, without change of atomic weight. These processes are somewhat involved; but they appear to me to be a reasonable hypothesis, although further proof is desirable. This proof is evidently to be furnished by accurate determinations of the atomic weight of lead associated with thorium minerals on one hand and with radium minerals on the other. Supposing each variety of "lead" to be pure, the sample of "thorium lead" should have an atomic weight of about 208, while that of the "radium lead" should be about 206. Determinations with this object in view are now in progress. The word "isotopic" is suggested as a fitting name for two elements, both occupying the same place in the periodic table. In his account of the theory, due credit is given to Fleck, Russell, and Fajans, the last of whom stated independently an almost identical hypothesis.

The difficulty of two elements having an identical spectrum is considerable; it is suggested that inasmuch as the spectra are characteristic of the movement of the electrons in an element, rather than of its mass, two elements in which the electrons will have identical motions must have the same spectrum. Mr. Aston's researches on two "neons," which can be separated from each other by diffusion, but which show no difference in spectrum, are adduced as proof of this point of view. It will be remembered that it was owing to Sir J. J. Thomson's finding that ordinary neon contains a small proportion of an element of atomic weight 22, which led to Mr. Aston's research. Here, again, one can only wonder that two elements, neon I. and neon II., of different atomic weights, 20 and 22, which can be separated by diffusion, according to Mr. Aston, have identical vapour-pressures, for they cannot be separated by fractional distillation.

Mr. Soddy has invented a modification of the periodic table which represents his new arrangements; it is three-dimensional.

Much of the book under review is taken up with detailed discussion of the generalisation of which a brief account has been given. The concluding section on the "Nature of the Argon Gases," puts forward the view that these elements are inactive owing to their great affinity for their valency electrons. Whereas an atom of sodium, in combining with an atom of chlorine, loses an electron to the chlorine, itself becoming an ion, an atom of argon has no such tendency, being very firmly bound to its electron.

This work of Mr. Soddy's must be termed "provisional"; it brings before the reader the state of knowledge regarding the sequence of radio-active elements, but it does more; it elaborates a hypothesis capable of correlating these facts; a very ingenious theory which, however, its author would be the first to acknowledge is still in need of support. W. R.

TECHNICAL MYCOLOGY.

(1) *Einführung in die Mykologie der Gebrauchs- und Abwässer.* By Dr. A. Kossowicz. Pp. vii + 222. (Berlin: Gebrüder Borntraeger, 1913.) Price 6.60 marks.

(2) *Die Gärungsgewerbe und ihre naturwissenschaftlichen Grundlagen.* By Prof. W. Henneberg and Dr. G. Bode. Pp. v + 128. (Leipzig: Quelle und Meyer, 1913.) Price 1.25 marks.

(1) DR. KOSSOWICZ surveys the subjects of water and sewage purification from the bacteriological point of view. To a large extent the book summarises researches that have been carried out on these subjects, though, on account of their number, the summary of each research is necessarily very brief. Its chief value consists in the contained bibliography—every page teeming with references to the literature—and the student, engineer, or hygienist desiring a guide for his practice will be bewildered by the mass of detail. Diagrams and figures of filters and filter-beds, sterilising apparatus, sedimentation tanks and plant for the biological treatment of sewage have been freely introduced, and form a useful feature.

The earlier chapters deal with the bacterial content of waters and the factors which modify it, the occurrence of pathogenic microbes in water, and the self-purification of water, and in subsequent chapters the subjects of sand-filters, chemical and other methods for the purification and sterilisation of water, sewage farms, the biological treatment of sewage, and the purification of trade effluents are considered.

(2) This little book gives a brief and simple, though at the same time excellent, survey of fermentations and the fermentation industries. The yeasts, bacteria, and moulds concerned in fermentations—alcoholic, souring of milk, acetic and butyric acids, etc.—are first described, with an account of their structure, development, and occurrence. The chemical composition of the substances fermented, the nature of the chemical changes involved, enzymes and enzyme action are next considered, and finally a description is given of the industrial processes involved in the production of beer, wine, and spirits, pressed (German) yeast, bread and vinegar, soured milk and "sauerkraut," cocoa and coffee. The text is illustrated with a number of figures of the micro-organisms involved and of the industrial plants employed in the fermentation industries.

R. T. HEWLETT.

HUMAN MATHEMATICS.

(1) *A First Book of Practical Mathematics.* By T. S. Usherwood and C. J. A. Trimble. Pp. iv + 182. (London: Macmillan and Co., Ltd., 1913.) Price 1s. 6d.

(2) *Practical Geometry and Graphics for Advanced Students.* By Prof. Joseph Harrison and G. A. Baxandall. Enlarged Edition. Pp. xiv + 677. (London: Macmillan and Co., Ltd., 1913.) Price 6s.

(3) *Practical Mathematics.* By Norman W. M'Lachlan. Pp. viii + 184. (London: Longmans, Green and Co., 1913.) Price 2s. 6d. net.

(4) *Exercices d'Arithmétique.* Enonces et Solutions. By J. Fitz-Patrick. Avec une Preface

de J. Tannery. Troisième Edition. Pp. vi+707. (Paris: A. Hermann et Fils, 1914.) Price 12 frs.

(1) IN the old days a boy had to reason in geometry "acording to the rules of the game." Many a boy felt that he must put aside common sense for fear that it might contradict the "rules," and that he must "play the game according to the rules." Hence came grotesque howlers, and the boy felt it unreasonable that grotesque results should be ridiculed, for they arose from strict adherence to rules. While in the present happy days we have altered that as regards geometry, the old method persists in algebra; the subject is treated in a purely abstract manner, it has no relation to anything in everyday life; the student can only commit to memory the rules of the game, and do his best to play the game. In this case the results also are generally abstract, so that appeal to common-sense would be impossible even if the boy allowed the validity of the appeal.

Now, however, a brighter dawn is breaking for the ill-treated boy. Usherwood and Trimble connect the algebraic work with the concrete throughout. The boy no longer has to play a game with rules he does not understand. Each algebraic process arises out of concrete instances, which are themselves easy of comprehension, and give a common-sense meaning to the process. The book is thus in the van of the movement to humanise algebra as geometry has been humanised, and in another generation no headmaster will mourn the blighting influence which $x+y$ had upon him.

The authors approve of the use of contracted methods, as do most of the best teachers at the present moment. We venture, however, to question whether these authors and teachers do well in this matter. It is customary to work to a significant figure more than will be required in the result; this generally gives the result to the required approximation, but not always. Are we to chance the accuracy, or are we to complicate the process further by an estimate of the trustworthiness of the result? Moreover, the estimation of the number of figures to be retained, even in the normal case, is a matter of no little skill; we have frequently known professors and schoolmasters of good standing to be at fault.

There appears to be no educational principle at stake, and the question is simply whether contracted methods conduce to speed and accuracy or not. Does the shortness of the contracted calculation compensate for the time spent in deciding how far to contract, and for the chance of error by excessive contraction? For the expert calculator, like the teacher of arithmetic or the observatory computer, it compensates without doubt. For ourselves, and we imagine for most people (adults and children), contracted methods in their strict form do not compensate. For us the best way is to calculate stolidly through, and at the end throw away the unnecessary figures, or if the numbers get very heavy, to contract to a modified extent, keeping, perhaps, two or three more figures than a strict contractionist would allow.

(2) Why do the universities so carefully exclude Mongian geometry from their "pure" mathematical courses? To many a pure mathematician the happening upon such a book as Harrison and Baxandall's is like the acquisition of a new sense. His ideas of solid geometry are those of Euclid's Eleventh Book, in which he is instructed to "draw a plane through three given points," or to carry out in three dimensions some construction that has been discussed in the plane, and which he had imagined was meant to be carried out on a sheet of paper with ruler and compasses. On arriving at the Eleventh Book he discovers that when Euclid says "draw a plane through three given points," he only means that three points determine a plane; on the Book I. construction carried out in three dimensions he has to put such interpretation as he can.

In course of time he happens upon a book on Practical Solid Geometry and regions unknown to Euclid and the universities. With what joy he finds that it is possible to represent points in space upon a sheet of paper, and actually possible to draw a plane through them. He wishes he was young again so that he might follow up all the wonderful consequences, actually carrying out all the constructions and not merely talking about "how it is done," as was his custom at the university. And Harrison and Baxandall would be a first-rate book to use if he could be young again. It contains the most alluring problems, wonderful in variety. There are no watertight compartments, but every branch of mathematics that can help is allowed to do so. The language, moreover, is excellent, a statement that cannot always be made of English mathematical writing.

Part III. of Messrs. Harrison and Baxandall's book is Graphics, an admirable subject, neglected in pure mathematics in the same unaccountable way as Mongian geometry. The story runs that Prof. P. G. Tait held that the analytical method was always superior to the graphical, and applied it to ascertain the stresses in the Forth Bridge. Although a man of unrivalled intellectual power he failed that time. Those days are gone, the schools are learning the value of Graphic Statics, and perhaps in time the universities may follow.

(3) Mr. M'Lachlan's book is mainly a collection of exercises in geometry, arithmetic, algebra, and trigonometry. They are all good, natural questions, straight from the workshop and other human sources. For the engineering student (for whom they are designed) they are ideal, while other students also will find much of value. The text is inferior in value, as if the writing of it had been a perfunctory task; but there is not much text, and the exercises alone are well worth the half-crown at which the price is fixed.

(4) M. Fitzpatrick's book of exercises in algebra might have been written for the express purpose of enabling English mathematicians to thank God that they are not as other men. There are 1300 questions, drawn mainly from French examination papers. The book contains all the old artificial questions which England is in process of discarding, and among the whole thirteen hundred we have been unable to find one natural problem taken straight from human life. In one particular, however, it is for the English mathematician to drop the *rôle* of Pharisee and take up that of Publican. We have nothing but praise for the clearness and exactness of the language of M. Fitz-Patrick's book, while in the first and third of the English books now under review we find carelessness of language that often produces ambiguities, and sometimes amounts to misstatement. In language we have much to learn from France. D. B. M.

OUR BOOKSHELF.

The Child: Its Care, Diet, and Common Ills. By Dr. E. Mather Sill. Pp. viii+207. (New York: Henry Holt and Co.) Price 1 dollar net.

In the modern nursery the mother requires information on many questions which used to be disregarded or left entirely to the discretion of the doctor. She now realises that in her kingdom of the nursery, preventive medicine depends to a large extent upon her care and foresight. If she provides her children with the conditions they require for healthy development, they tend to remain well and happy, and the services of the physician will be required seldom.

Dr. Sill has had a large experience of children's medicine, and, in this small volume, he has contrived to present, in simple language, much valuable information on the clothing, feeding, general hygiene, and minor ailments of children. It is an unpretentious book, admirably adapted to its purpose as a handbook for young mothers. It is well printed, and is supplied with attractive illustrations and an index.

Some useful tables are included, and a few recipes for invalid dishes, together with clear directions for the preparation of simple domestic remedies, such as the various kinds of medicated baths. The common slight ailments of childhood are described, and a list is given of the poisons most liable to invade the nursery, together with their domestic remedies.

In every treatise on infant care, the instructions for the modification of cow's milk for bottle-fed babies are apt to be involved and lengthy, and perhaps in the little volume under review the author has not been entirely successful in avoiding this fault.

The book closes with advice to parents to tell their children some elementary physiological facts about the phenomenon of reproduction and the care that they should take of their bodies. This wise advice is strengthened by suggestions as to the best way of explaining these matters to children.

Dr. Sill's book is one to recommend cordially, as it is certain to be appreciated by those for whom it is intended.

An Account of the Morisonian Herbarium in the possession of the University of Oxford. By Prof. S. H. Vines, F.R.S., and G. Claridge Druce. Pp. lxviii+350+plates. (Oxford: Clarendon Press, 1914.) Price 15*s.* net.

All who take an interest in the history of botany, and especially the history of botany in Britain, will be glad to see the second work on the Oxford Collections, which has just been issued under the joint authorship of Prof. Vines and Mr. Druce. These names are a guarantee both of accuracy and of erudition, nor will the reader fail to discover on every page of the interesting and valuable introduction a breadth of acquaintance with the old literature, as well as with sources of information by no means readily accessible. The position of the Bobarts, father and son, in relation to the carrying out of Morison's great work, is made very clear, and, incidentally, the earlier history of the Oxford Botanic Garden is well told in the letters and remarks of those who were interested in its inception and early progress.

The bulk of the work is occupied by the "Plantarum Historiæ universalis Oxoniensis, pars secunda et pars tertia." The second part of the "Historia" was issued by Morison, while the younger Bobart was entrusted with the completion of the third part. In the present work, in which the plants are enumerated, the modern reader will find the critical notes incorporated by the authors of great service in identifying the older names and descriptions. The book is a scholarly one, and well worthy of the reputation of its authors.

A Gypsy Bibliography. By Dr. G. F. Black. Pp vii+226. (London: Bernard Quaritch, 1914.) Price 15*s.* (Gypsy Lore Society, Monograph No. 1.)

For the first time, Dr. G. F. Black, of the New York Public Library, has undertaken the difficult task of compiling a comprehensive bibliography of gypsy literature. A preliminary edition of this bibliography was issued for revision by European and American scholars in 1909, and the information thus obtained has been used in the present compilation, which includes 4577 entries, accompanied by a good subject index. No attempt has been made to sift the chaff from the wheat, and many books and articles now included have obviously no claim to be regarded as scientific authorities. In a new edition it would be well to define by special type those publications which are really of value. The leading writers on gypsy lore have been fully dealt with—Borrow with 103 entries, Wlislocki, 182, and Bataillard, 41; while the work of English authorities like MacRitchie, Sampson, Thompson, and Winstedt, is adequately recorded.

The bibliography is prepared on scientific principles, and footnotes to the more important articles supply useful information. It is disappointing to note that the Oriental material has been less carefully examined than that of the West. For example, in the case of India, much second-rate material is recorded, while the records of recent ethnographical surveys, and locally published books and pamphlets have often been neglected. It may be hoped that in a new edition the libraries of the India Office, Royal Asiatic Society, the Imperial Library at Calcutta, and other local sources will be more carefully examined.

A Textbook of Domestic Science for High Schools. By Matilda G. Campbell. Pp. vii + 219. (New York: The Macmillan Company, 1913.) Price 4s. net.

HAD this book been published a few years ago in this country it would probably have been described in its title as a book of "domestic economy." It is concerned chiefly with cookery, which is regarded frankly as an art, and taught as usual by recipes. The treatment is not scientific in the proper sense, and the few chemical formulæ and statements of fact about chemistry introduced will serve only to confuse the student. Under a different title, and with some omissions, we should have here a good book on practical cookery.

The Religious Revolution of To-day. By Prof. J. T. Shotwell. Pp. ix + 162. (Boston and New York: Houghton Mifflin Co., 1913.) Price 1.10 dollars net.

PROF. SHOTWELL here publishes the William Brewster Clark Memorial lectures he delivered last year at Amherst College. These lectures are in memory of Dr. W. B. Clark, who graduated from Amherst in 1876, and their object, a foreword to the volume states, is to assist "in throwing light in a genuinely scientific spirit upon the relation of the research, discovery, and thought of the day to individual attitude and social policy." The titles of the lectures are: "Contrasts," "Devolution or Evolution?" "The Problem and the Data," and "The New Régime."

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.]*

Active Nitrogen.

A FURTHER paper by Tiede and Domcke has appeared (*Berichte*, February 7, 1914) in which it is stated that bomb nitrogen passed over copper moderately heated (to about 400° C.) is incapable of giving the glow characteristic of active nitrogen. This is held to confirm the previous statement by the same authors relative to nitrogen prepared by heating a metallic azide. In each case the result is attributed to the successful elimination of any trace of oxygen.

We have carefully repeated this new experiment, taking every precaution. All parts of the apparatus were sealed together by fusion. Its lightness was thoroughly tested, both before and after the experiment, and occluded gases were carefully got rid of. The column of copper employed consisted of rolls of the finest gauze (ninety threads to the inch), carefully reduced from the oxidised condition. Its length was 50 cm., and its diameter 17 mm. The temperature was slowly taken up from 15° C. to 480° C., without any distinct change in the intensity of the glow at any stage. The experiment has been repeated on several occasions before colleagues. A subsequent examination of the copper showed that oxidation had not proceeded for more than 8 cm. We emphatically dissent therefore from Tiede and Domcke's conclusion, in this case, as in the previous one.

The rest of their paper is an attempt to show that some of the characteristic effects can be got with oxygen only, in the entire absence of nitrogen. We must content ourselves here with saying that we do not agree with their observations, but that these would not tell against the existence of active nitrogen, even if they were correct. The conclusive fact is the capacity of the gas to react with, *e.g.* hydrocarbons, to form hydrocyanic acid. This they have not attempted to dispute.

We are glad to see that Koenig and Elöd (*Berichte*, February 21, 1914) are in agreement with us that azide-nitrogen gives the glow perfectly well.

H. B. BAKER.
R. J. STRUTT.

Imperial College of Science, March 3.

Remarkable Upper-Air Records at Batavia.

Two sounding-balloons liberated at Batavia during the present rainy season have met with exceedingly low temperatures, when entering the stratosphere at the usual height of about 17,000 metres (10·6 miles).

On December 4, 1913, −90·9° C. (−131·6° F.) was registered, and on November 5 −91·9° C. (−133·4° F.). Though in this last case the clockwork had stopped, the register may be accepted without reservation. I believe this air temperature of −91·9° C. to be the lowest on record.

On December 4 the balloon (weight 2·2 kg.) reached a height of 26,040 metres (16·2 miles), and the registering, both in the ascent and in the descent, is to be depended upon, as will be proved below. What is most remarkable in the temperature record is that from 17,000 metres upward an increase from −91·9° C.

to $-57{\cdot}1^\circ$ C. is shown, the latter agreeing with the value which is usually found in Europe. In former balloon ascents made at Batavia, temperature records have been obtained only twice for heights above 20 km. In one of those cases (August 6, 1913), an increase similar to that of December 4 was recorded, viz., $-82{\cdot}6^\circ$ C., at 17 km., and $-63{\cdot}7^\circ$ at 22 km.; in the other case, however (October 2, 1912), the temperature showed a much smaller increase (-80° C. to -75° C.), the balloon reaching 23 km.

Regarding the trustworthiness of the records, the scale-values of the thermo- and barograph may be entirely depended upon, the instruments having been subjected to thorough verification before the respective ascents.

The only seemingly prejudicial circumstance is that, though the balloon was liberated before sunrise, the sun rose above the horizon as the balloon entered the stratosphere, so that the insolation may have caused an apparent rise of temperature, notwithstanding the sun was low in the sky. Comparison of the temperature records for ascent and descent, however, prove that this has not been the case. The balloon descended at a quicker rate than it ascended; accordingly ventilation was more efficient in the downward movement, and consequently any heating effect of the sun-rays smaller. Thus we should expect higher temperatures during the ascent, even if we take into account that the sun had risen higher in the meantime. On the contrary, however, on December 4 the temperatures during ascent were lower than, and on August 6 nearly equal to, those recorded during descent. The higher temperatures in the descent on December 4 are easily explained as an effect of sluggishness of the thermograph, especially as the sign of the difference between ascent and descent changes with the temperature gradient, when going from the troposphere to the stratosphere, quite in accordance with any effect of sluggishness. The values of temperature and ventilation are given here for heights from 15 km. upwards :—

Height in km.	Temperature Ascent	Temperature Descent	Average	Temperature higher in ascent	Ventilation (m.p. sec.) Ascent	Ventilation (m.p. sec.) Descent
	°C.	°C.	°C.	°		
15	−76·4	−79·6	−78·0	3·2	0·5	1·6
15·5	−79·0	−84·0	−81·5	5·0		
16	−83·1	−89·1	−86·1	6·0	0·4	1·6
16·5	−87·1	−90·9	−89·0	3·8		
17	−89·5	−89·7	−89·6	0·2	0·3	0·9
17·5	−88·8	−85·8	−87·3	−3·0		
18	−87·4	−83·2	−85·3	−4·2	0·4	0·5
19	−81·3	−74·9	−78·1	−6·4	0·2	0·6
20	−74·5	−68·9	−71·7	−5·6	0·2	0·6
21	−69·7	−66·7	−68·2	−3·0	0·2	0·7
22	−67·8	−64·2	−66·0	−3·6	0·2	0·7
23	−64·0	−62·0	−63·0	−2·0	0·2	0·7
24	−60·0	−60·0	−60·0	0·0	0·2	0·7
25	−59·4	−59·4	−59·4	0·0	0·2	0·2
26	−57·2	−57·2	−57·2	0·0	0·2	0·2

As to the temperature gradients, it may be remarked that in the stratosphere they show a succession of low and very high ($>1{\cdot}0$) values.

I believe the remarkable behaviour of temperature in the tropical stratosphere, revealed by these upper-air soundings, will furnish a key to the explanation of the two salient features of the stratosphere, viz., the lowering of the temperature at its base and its rise in height, when proceeding from the poles to the equator.

W. VAN BEMMELEN.

Batavia, January 23.

The Vertical Temperature Distribution in the Atmosphere.

In the observations described by Dr. van Bemmelen in the foregoing letter, the vertical temperature distribution in the tropics is so typically represented that it seems worth while to consider a little more closely the essential difference between the curve obtained from them and curves obtained in temperate latitudes, and to discuss its probable cause. This difference, as Dr. van Bemmelen has pointed out already, chiefly relates to the greater height of the stratosphere and the large and rapid increase of temperature in it.

As to the vertical temperature distribution in higher latitudes, theory has already been able to give account of its principal properties. These theories (Humphreys, Gold, Emden[1]), however, deal only with those latitudes and not with the particular features of the tropical atmosphere. I will briefly formulate the results of these researches so far as they will be used in the further discussion.

(1) When convective temperature equilibrium is supposed to exist and the decrease of water vapour with height is taken into account, Gold finds that above the isobaric surface of a quarter atmosphere, radiation has a heating effect, below a cooling influence. In Europe this surface has a height of 9500 metres. With a slightly different conception as to the distribution of water vapour Emden calculates nearly the same height for the limit between heating and cooling effect, viz., 8950 metres.

(2) According to Emden, his equations used for the lower regions do not hold good in the upper part of the troposphere in consequence of the very small quantity of water vapour. Taking this small amount of vapour into account, he derives a minimum radiation temperature of -59° C. Supposing the condition in (1) to be gradually changing into those mentioned in (2), his theory fully agrees with the facts observed over the tropics.

(3) The equations of Emden show at greater elevations a gradual increase of temperature in the stratosphere, in agreement with the results of observation.

The very low temperatures, observed in the upper part of the tropical troposphere, which are about 30° C. below those observed at the same height in temperate regions, must be ascribed to another effect. Besides the radiation and the resulting vertical convection currents, which explain the principal features of the gradients in higher latitudes, in the low-pressure belt of the tropics the rising air currents of the general atmospheric circulation cooperate. They disturb the temperature distribution as determined by radiation, and shift the troposphere to greater heights.

Dr. van Bemmelen, who found at Batavia the upper limit of the anti-trade winds at about the same level as the base of the stratosphere, thereby proved that the convection currents reach as high as the upper limit of the troposphere.

Also from a theoretical point of view, it is evident that the vertical convection currents do not reach higher than the limit of strato- and tropo-sphere, as this would be inconsistent with the stability of the temperature gradients of the stratosphere; on the other hand, it is improbable that their height remains much below this limit, for without convection the high radiation temperatures would rapidly take possession of their dominion.

At higher levels the conditions in the stratosphere will rapidly approach those of the temperate latitudes at the same height. Therefore the marked increase of temperature, as shown by the observations is exactly what might be expected.

[1] R. Emden: Uber Strahlungsgleichgewicht und atmosphärische Strahlung. Ein Beitrag zur Theorie der oberen Inversion. Sitz. Ber. d. math.-phys. Klasse d. K. B. Akad. d. Wiss. zu München, 1913, Heft 1.

The upheaval of the stratosphere in the tropics may be demonstrated in a very instructive way by comparison of its height with the height of the cirrus clouds. In my opinion, as indicated below, the base of the cirrus fairly well represents the height of the hypothetical dividing surface between the cooling and heating effect of radiation for moist air (as mentioned in (1)). This surface is one of nearly uniform temperature, as shown by the temperatures of the cirrus level:—

Bossekop (70° N.L.),	height of cirrus 8·3 km.,	temp.	−45° C.
Potsdam (52° N.L.),	,, 9·2	,,	−46° C.
Batavia (6° S.L.),	,, 11·4	,,	−48° C.

Parallel to this surface runs the base of the stratosphere, the analogous dividing surface for atmospheric air (that is, for rather dry air as mentioned in (2)), with a nearly constant temperature of −55° C. The deviation from this parallel intercourse, which appears in the tropics and subtropics, in consequence of a shifting which only affects the upper surface, gives a direct measurement of the disturbing influence of the vertical convection currents belonging to the general circulation.

In the *Meteorologische Zeitschrift* of 1913 (Heft 10, p. 493) I have already discussed the question of the cirrus level as a dividing surface for radiation effects. In this paper, which may be referred to here, attention was directed to the fact that there exists an essential difference between the cloud formation in the cirrus level and above it, as compared with the lower regions, a phenomenon very evident in the quiet tropical atmosphere. The upper part of the high cumulus clouds (their height may be estimated at about 13 or 14 km.) does not, as the lower part, dissolve rapidly, but assuming a flattened form and cirrostratus-like appearance, it remains drifting along for a considerable time. This difference I attributed to a cloud-dissipating (cooling) effect of radiation in the lower, and a cloud-forming (heating) effect in the upper levels.

As a fixed amount of water radiates and absorbs more strongly in the condensed form than in the gaseous state, in the regions where radiation has a cooling effect, as in the lower strata of the atmosphere, the cooling will be relatively strong in the clouds as compared with the surrounding air. But a heating effect will be experienced in the clouds in higher levels, where radiation is heating them more intensely than the surrounding air. When left to themselves, after convection has finished, they will descend and dissolve in the first case, but, on the contrary, will be upheld or rise, and consequently prolong their existence or develop in the second case.

At that time I had not read Emden's paper. By attributing the relatively low radiation temperatures of the air at these heights to ozone, I tried to explain the circumstance of the different radiation effect observed either with regard to the cirrus clouds or to the air in which they are floating.

Perhaps such an influence cooperates, but Emden's results mentioned above may also explain the matter. It is very probable that his statement (1) may be applied to clouds on account of their large amount of water in condensed and gaseous form. In this case the limit above which radiation has a heating effect (8950 metres) is indeed situated just below the cirrus level, which at Potsdam has a height of 9200 metres. As to radiation, the conditions in the surrounding air at this height approach those mentioned in (2), and the radiation effect will still remain a cooling one. Thus the lower limit of the cirrus clouds may be regarded as the level where, for air of abundant water contents, the influence of radiation changes its sign.

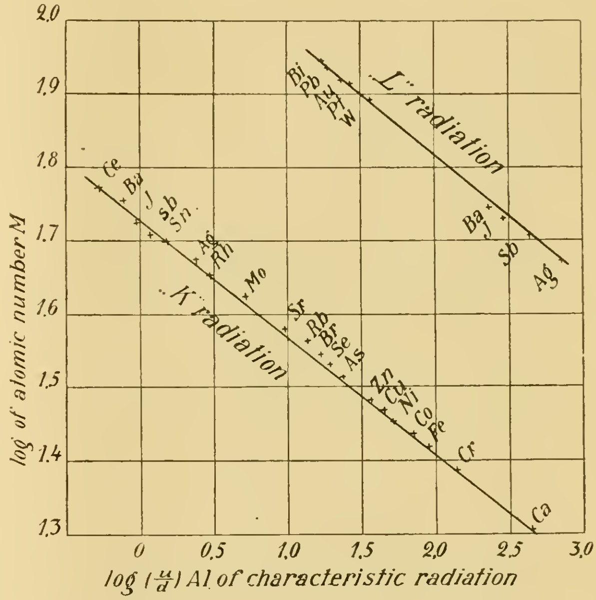
Batavia, January 23. C. BRAAK.

Atomic Models and Regions of Intra-atomic Electrons.

THAT, as concluded by Prof. Nicholson (NATURE, February 5, p. 630) the atoms of lithium, beryllium, and boron cannot consist of 3, 4, 5 electrons rotating round a nucleus of 3e, 4e, 5e, respectively, with equal angular momenta in one circular orbit, may be concluded also from the periodic system, as instead of 1, 0, 1, 2, 3 electrons of valency, we should then expect a regular increase from 0 to 5, or no valency at all. No atomic model, so far as I know, has succeeded in making this difference plausible; but it is not essential to the hypothesis, that, independently of any atomic model:—(i) Three distinct regions of intra-atomic electrons exist, the number of which (say P, Q, R) may be calculated for each atom from the periodic system; and (ii) on these numbers most, if not all, of the non-periodic properties of the elements depend, so that (NATURE, December 25, 1913, p. 476):—

(i) M = P + Q = (1) the charge on the nucleus on Rutherford's theory; (2) the number of electrons surrounding that nucleus; (3) the atomic number of an element in Mendeléeff's series.

P = (1) the number of peripheric electrons (those of



valency included); (2) $8r+p$ (p being the maximum valency and r the number of rows preceding that of the element: rare-earth period not counted).

Q = (1) the inner electrons, giving probably the characteristic radiation; (2) the number of aperiodic elements (H, He, Co, Ni, &c., and rare-earth elements).

R = (1) the free nuclear electrons of which part can be ejected as β rays (Bohr, *Phil. Mag.*, vol. xxvi., p. 501, 1913); (2) A/2 − M, if the positive part of the nucleus consists of α particles for by far the greatest part; (3) kP^2, as $A/2 - M = kP^2$ for all elements (NATURE, December 25, p. 476); and that:—

(ii) On M, or some function of it, depend (1) the large-angle scattering of α particles (NATURE, November 27, p. 372) (on M^2); (2) wave-number of the characteristic radiation for elements from nickel to zinc (on $(M-1)^2$) (Moseley, *Phil Mag.*, vol. xxvi., p. 1024, 1913); (3) the absorption of the characteristic radiation for all elements (see figure); (4) the minimum velocity of β rays required to produce it (on M or M − 1); (5) for hydrogen M only gives a possible value for the charge, and normal values for absorption, etc., while A/2 does not.

And (iii) on P, or some power of it depend (see table) (1) the percentage of the incident β radiation reflected for UrX, RaE, Act D); (2) the absorption of kathode, or β rays (see Lenard, *Ann. d. Phys.*, vol. lvi., p. 275, 1895, and Crowther, *Phil Mag.*, vol. xii., p. 379, 1906); (3) the number of nuclear electrons and β particles ejected (see Soddy, *Jahrb. Radioakt. und Elektronik*, 1913, vol. x., p. 193); (4) quanta of energy the β particle looses on Rutherford's theory (*Phil Mag.*, vol. xxvi., p. 717, 1913) in traversing the non-nuclear electrons of the atom it came from; (5) probably the decrease of velocity of α particles traversing matter (Bohr, *Phil. Mag.*, vol. xxv., p. 27, 1913). The table gives the number of electrons, causing this decrease, in approximate values.

	P	$\frac{\mu}{D}$	$\frac{10\mu}{NP^2}$	Perc. Refl. β rad.			Perc. Refl. β rad./$P^{\frac{1}{2}}$			N, Bohr
				UrX	RaE	AcD	UrX	RaE	AcD	
Al	11			27	30	38	8·2	9·0	(11·5)	14
Fe	24	6·4	6·2	41	41	47	8·4	8·4	9·6	
Ni	24			43	43	48	8·9	8·9	9·8	
Cu	25	6·8	6·9	43	45	52	8·5	8·9	10·4	
Zn	26	6·95	6·7	43	45	53	8·5	8·9	10·3	
Ag	41	8·3	5·3	55	57	63	8·6	9·0	9·9	
Sn	44	9·5	6·4	57	62	70	8·7	9·4	10·5	38
Pt	56	9·4	5·9	66	68	78	8·8	9·1	10·4	
Au	57	9·5	5·8	68	68	79	9·0	9·0	10·4	61
Pb	60	10 8	6·2	68	70	80	8·8	9·1	10·3	65
Bi	61			70	71	81	9·0	9·1	10·4	
			6·2				8·67	8·98	10·19	

From (ii, 2) $n=c/\lambda=2{\cdot}465.10^{15}(M-1)^2$; from (ii, 4) $V_{min}=2{\cdot}24.10^8(M-1)$. Now $V_{min}>v$ of the electron giving K-radiation, and if this $=1{\cdot}93.10^8(M-1)$, then $mv^2/2n=0{\cdot}88.1{\cdot}93.^2 10^{-11}/2.2{\cdot}465.10^{15}=6{\cdot}62.10^{-27}=$ Planck's h.

A. VAN DEN BROEK.

Gorsel, Holland, February 9.

An Early Slide Rule.

DE MORGAN, in article "Slide Rule" in the *Penny Cyclopaedia*, points out that though Gunter first used a logarithmic scale, the real inventor of the logarithmic slide was Oughtred. "In the year 1630 he showed it to his pupil, William Forster, who obtained his consent to translate and publish his own description of the instrument, and rules for using it. This was done under the following title, 'The Circles of Proportion and the Horizontal Instrument,' London, 1632; followed in 1633, by an 'Addition, etc.,' with an appendix having title, 'The Declaration of the two Rulers for Calculation.'" After referring to a republication of this work in 1660, he goes on:—"The next writer whom we can find is Seth Partridge, in a 'Description, etc., of the Double Scale of Proportion,' London, 1685. He studiously conceals Oughtred's name; the rulers of the latter were separate, and made to keep together in sliding by the hand; perhaps Partridge considered the invention his own, in right of one ruler sliding between two others kept together by bits of brass."

Prof. F. Cajori, in his book, "A History of the Logarithmic Slide Rule," 1909, the result of an exhaustive inquiry into the literature of the subject, quotes De Morgan, and continues (p. 17), "To Partridge we owe, then, the invention of the slide." In an addendum (p. vi.), and in NATURE, February 24, 1910, p. 489, he refers to a copy of Partridge's book in his own possession, published in 1662, in which it is stated that the book was written in 1657.

Dr. Alexander Russell, in NATURE, January 30, 1910, p. 307 states:—"A few years before 1671, Seth Partridge rediscovered the sliding principle, perfected it, and gave an almost complete specification for the slide rule which is used to-day by engineers. . . . Personally, I consider that Seth Partridge is the real inventor of the modern 10-in. slide rule."

My object in writing is to direct attention to the fact that there is in the Science Museum at South Kensington a slide rule which is inscribed, "Made by Robert Bissaker for T. W., 1654." This proves that the slide was invented and *in use* three years before Partridge wrote his pamphlet, and eight years before the earliest known date of its publication.

This very early example of the instrument is of boxwood, well made, and bound together with brass at the two ends. It is of the square type, a little more than 2 ft. in length, and bears the logarithmic lines first described by Edmund Gunter. Of these, the *num.*, *sin.*, and *tan* lines are arranged in pairs, identical and contiguous, one line in each pair being on the fixed part, and the other on the slide. As Seth Partridge describes no feature which is not embodied in this example of the instrument, it would appear that less credit is due to him for invention in connection with the slide rule than has hitherto been given.

In this year of the Napier tercentenary celebration it is interesting to know that a slide rule is still in existence which was made only forty years after the invention of logarithms.

DAVID BAXANDALL.

The Science Museum, South Kensington, S.W.

The Permeability of Echinoderm Eggs to Electrolytes.

IN 1910 J. F. McClendon showed that the electrical conductivity of echinoderm eggs is considerably increased after fertilisation, and inferred from this fact that the act of fertilisation causes an increase in the permeability of the egg-surface to electrolytes. In his recent book ("Artificial Parthenogenesis and Fertilisation") Prof. Loeb suggests that the increase in conductivity is not due to an increase in permeability, but would be produced "if in consequence of membrane-formation the degree of electrolytic dissociation of the surface film of the egg should be increased" (p. 122).

I have recently found that the electrical conductivity of unfertilised and fertilised eggs is very greatly affected by the presence of very low concentrations of simple trivalent positive ions; a concentration of 0·0002M $Ce^{\cdots}$ decreases the conductivity of the unfertilised eggs of *Sphaerechinus granularis* by as much as 40 per cent. Such solutions likewise affect the conductivity of the fertilised eggs, but to a less degree. Whereas it is almost inconceivable that these phenomena are due to a decrease in the electrolytic contents of the surface-film of the egg, I have found considerable evidence in support of the suggestion that the electrical conductivity of these eggs is determined, at least partially, by the charge on the egg-surface. As Perrin, Girard, and Mines have shown, this factor also determines the degree of permeability of membranes to electrolytes. In short, McClendon's original contention, that the increase in electrical conductivity of eggs after fertilisation is due to an increased permeability of the egg-surface, is very much more satisfactory than Prof. Loeb's suggestion.

J. GRAY.

Stazione Zoologica, Napoli, Italy.
February 5.

THE BEGINNING OF ART.[1]

THE subject of prehistoric art has never failed to engage the public interest. It not only exhibits to us the beginning of all that is now embraced under the comprehensive term of Art, but it furnishes us with a more clear and precise insight into the mind of prehistoric man than can be given by any other branch of archæology. The authenticity of the records again has never, and can never, be seriously questioned by the most sceptical or the least learned in these matters.

For a long time the examples of prehistoric art were limited to carvings or gravures, the medium being bone, horn, or tooth, but since 1887, and particularly since 1901, attention has been more directly focussed upon the incised figures found on rocks, usually on the walls of caves, and not infrequently coloured with ochre. The caves so decorated are chiefly found in the Dordogne district of France, and along the Cantabrian coast of Spain.

Although the honour of first appreciating the significance of these paintings belongs to the late M. Piette, it is to the enthusiasm, ability, and labours of Abbé Breuil that we are chiefly indebted for most of our knowledge regarding them. A good example of the peculiar ability of Abbé Breuil, amounting indeed to what might be justifiably regarded as genius, for seeing things which are hidden from less acute observers, is given on pp. 146–8 of the volume on "La Caverne de Font-de-Gaume." In May, 1906, Abbé Breuil on casually looking through Abbé Parat's collection of "pierres utilisées," found on one of them what he conceived to be the head and fore part of a rhinoceros. A further more minute examination led him to the opinion that there were two silhouettes of a rhinoceros almost superimposed upon each other. M. Breuil showed the specimen to M. Salamon Reinach, who, however, was only able to decipher the two outlines when they were traced for him with a pencil. M. Boule was next shown the specimen, but expressed himself as sceptical on the matter. A few days afterwards a galvano-plastic impression was obtained at the Musée de Saint Germain, which removed all question of doubt as to the accuracy of the Abbé's opinion, as M. Boule readily acknowledged.

In the present publication Abbé Breuil has had the advantage of the cooperation of MM. Capitan et Peyrony for the French caves, and of MM. Rio et Obermaier et Père Lorenzo Sierra for the Spanish caves. Mention is also certainly due to M. Lasalle, for the very valuable and highly efficient services which he has rendered under very great difficulties in photographing the "paintings." Last but not least, we are indebted to S. A. S. le Prince de Monaco, who has shown his appreciation of the value of these records in the most practical way by undertaking their publication, increasing materially thereby the great debt which all archæologists already owe him.

Those who have seen the previous publications under the same auspices will be prepared for something as near perfection as anything can well be, nor will they be disappointed, for these books in matter and form, in text and illustration, leave nothing to be desired.

The caves in which these wall paintings are found occur in Cretaceous Limestone, and are both very extensive and tortuous. The "pictures" begin only after a certain distance has been traversed from the entrance, but this is to be explained, as the authors point out, on the ground that those at or near the entrance have become blurred and effaced by atmospheric agencies.

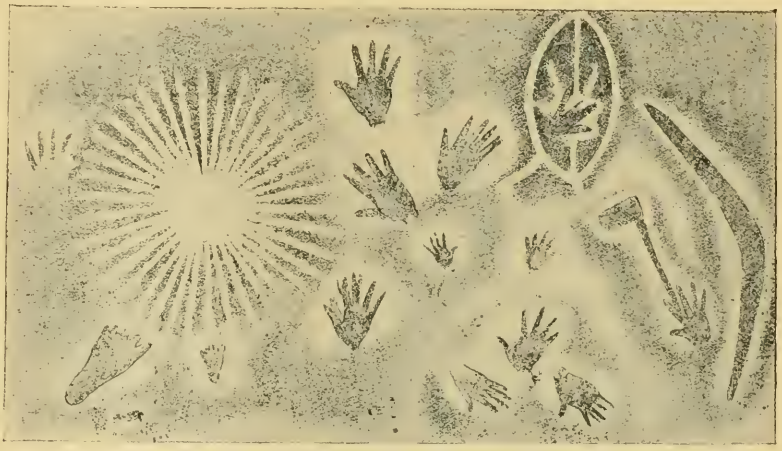


FIG. 1.—Hands, feet and weapons printed in colour on a rock in Australia (after Worsnop). From "Les Cavernes de la Région Cantabrique."

A large number of pieces of flint adapted for the purposes of drawing, and pieces of ochre suitable for colouring the figures, have been recovered from the caves, and the presumption that they were the actual instruments and material used is very strong. The date of the "paintings" may be assigned to the Aurignacian, Solutrean, and Magdalenian periods, possibly even to the end of the Mousterian. The pictures themselves are nearly all concerned with the portrayal of the larger members of the fauna existent at the period, the mammoth, rhinoceros, bison, bear, horse, deer, goat, wolf, &c. The interest attached to them is manifold. There is their intrinsic interest as works of art produced at a very remote period, there is the interest arising out of the change which takes place in the technique, and permits of our identification of no fewer than five distinct periods. Then there is the zoological interest, for the animals are so carefully drawn,

[1] "La Caverne de Font-de-Gaume aux Eyzies (Dordogne)." Par le Docteur L. Capitan, l'Abbé Henri Breuil et D. Peyrony. Pp. viii+271+lxv plates.
"Les Cavernes de la Région Cantabrique (Espagne)." Par H. Alcalde del Rio, l'Abbé Henri Breuil et le R. Père Lorenzo Sierra. Pp. viii+265+100 plates.
"La Pasiega a Puente-Viesgo (Santander)." Par l'Abbé Henri Breuil le Docteur H. Obermaier et H. Alcalde del Rio. Pp. 64+xxix plates. (Monaco: Imprimerie Artistique Vve A. Chene, 1910–13.)

with such attention to detail, that they afford very strong evidence as to the appearance of these species now in many cases extinct. Lastly, there is the interest attached to the chronological order of the paintings as it may be determined by an examination of those examples far from rare in which one figure is superimposed on another. The evidence from this source is not, however, so complete that we can tell the order in which certain animals have become extinct. We find by a curious caprice that the mammoth, for instance, in "La Caverne de Font-de-Gaume" appears only in "paintings" belonging to the first and fifth periods.

There is naturally a special interest in those frescoes in which Man himself is the subject. Unfortunately there is no clear and full representation of Man. The figure in the cave Hornos de la Peña is almost certainly not that of a man. There is, however, a very spirited delineation of a human arm in "La Pasiega," while the number of times in which the human hand is depicted is remarkable. Representations of the left hand preponderate greatly over those of the right hand, a fact which is explained no doubt rightly by assuming that man had already ceased to be ambidextrous. It is a very curious coincidence that among the native Australians the custom of drawing or painting the hand on the wall of a cave is not infrequently practised. The accompanying figures show how closely related such examples may be. In Australia the boomerang is often found associated, while in Spain instruments of a similar shape are also sometimes introduced. Naturally there are many other markings the meaning of which it is difficult to determine, "tectiform," "scutiform," "claviform" figures. It is tempting to think that some of the former are meant to represent huts, it is at any rate difficult to know what else they could be while their resemblance to the homes of primitive people in all parts of the world is striking.

The value of these important books, the great labour they have entailed, the vast knowledge they have exacted, will be readily granted when it is further noted that they include a "description raisonée" of all the animals depicted, a description based on an examination of all the art specimens extant representing the animals, whether gravure, carving, or "painting." There is again a very careful and scientific comparison made between these old examples and those of the modern African Bushman.

The books constitute, with the archæological books already published from the Monaco press, a series of classics which mark an epoch in the history of our knowledge of archæology. They enable us to view the past as through a telescope.

WILLIAM WRIGHT.

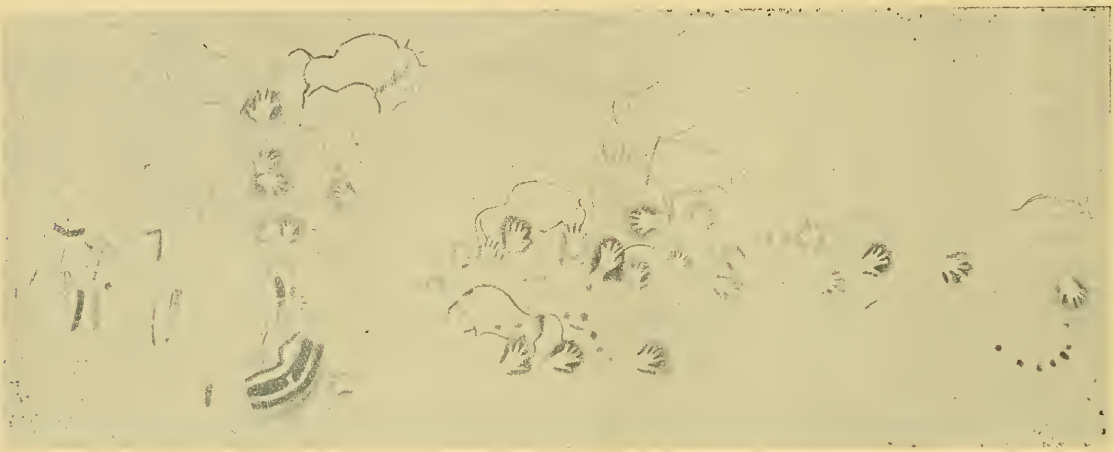


FIG. 2.—Fresco of hands, animals and weapons (?) on the wall of the cavern at Castillo. From "Les Cavernes de la Région Cantabrique."

THE HOPE REPORTS.[1]

IF anyone would undertake the task of writing the history of zoological science during the past fifty years, an interesting chapter could be written on the attitude of the leading authorities towards the work of the pure systematist.

Fewer than fifty years ago every zoologist who ventured to express his opinions on the philosophical questions that gathered round the science was a recognised authority on the systematic zoology of some one group of animals. Haeckel had studied the Radiolaria and Medusæ; Darwin wrote a monograph on the Cirripedia; Huxley contributed to our knowledge of the systematic zoology of the Siphonophora. But the time came when, for a period, the study of a special group was discouraged, and the student, passing from his course of general study, started on his investigations on embryology or morphology, without taking the trouble to become acquainted with the difficulties of systematic work, or to train himself in the observation of minute differences of structure upon which the arrangement of animals into specific groups must, in so many cases, be based.

[1] The Hope Reports. Edited by Prof. E. B. Poulton, F.R.S. Vol. viii, Appendix, 1890–1910, Including Five Sub-families of the Blattidæ. By R. Shelford. Vol. viii., 1910–13. With a Separate Appendix. Vol ix., 1911–13. The Natural History and Description of African Insects, especially the Acræine Butterflies. (Oxford, 1913.)

The value of such work was well expressed in the letter written by Huxley to Francis Darwin ("Life of Darwin," vol. i., p. 347), which begins with the sentence :—"In my opinion your sagacious father never did a wiser thing than when he devoted himself to the years of patient toil which the Cirripede book cost him."

The three volumes of the Hope reports that have recently been issued may be regarded as an indication of the revival of systematic zoology after a period of comparative neglect, and a sign that some of our best thinkers are beginning to realise that "the great danger which besets all men of large speculative faculty is the temptation to deal with the accepted statements of fact in natural science as if they were not only correct, but exhaustive."

The entomologists who are associated with Prof. Poulton in the Hope Department at Oxford are engaged in the study of large and important speculative questions, but, as these volumes show, their work is based upon the careful detailed study and descriptive statement which pure systematic work demands. They have the great advantage which the rapid growth of the collections in the Hope department affords of basing their conclusions upon the study of a very large number of specimens that have been sent to the museum from various parts of the world by the band of skilled collectors and keen observers that Prof. Poulton has interested in his work; and whether we agree with the conclusions or not, we must feel confident that the work has been done with a thoroughness and wealth of illustration that has probably been unequalled in the history of speculative zoology.

Our interest naturally centres, in the first instance, on the progress that has been made during the period, of which these volumes form the record, in the study of mimicry and protective resemblance. It has been urged so frequently as an objection to the theories of Batesian and Müllerian mimicry that the insects that are supposed to exhibit them are not subject to the attacks of birds or other vertebrates gifted with eyes that can see or be deceived by colour patterns; and that the palatability of their flesh cannot in any way be an advantage to them in their struggle for existence; that the experiments in this connection of Mr. Pocock on the palatability of British insects, and the observations of Mr. Swynnerton on butterflies attacked by birds in Rhodesia are of special interest. The negative evidence of observers who say they have never seen a particular species of insect attacked by birds is really of very little value compared with the positive evidence that is accumulating, and the onus of proof is now shifted from those who support the theory of mimicry to its opponents.

But a still more interesting discussion for the general reader upon which these volumes throw much new light is on the question of the origin of the mimetic forms. Have, for example, the four mimetic females of the well-known African butterfly *Papilio dardanus* arisen by sudden mutations, or by the natural selection of small variations from a common type? It will be difficult for Prof. Poulton to persuade the mutationists that they are wrong, that in this particular instance the many transitional forms between the dominant mimetic forms that the Hope collections include do indicate that it is by the selection of slight variations in the right direction that the similarity between the mimics and their models has been reached, but the gradually accumulating series of facts bearing upon this discussion which these volumes contain are of extraordinary value in giving those who have not yet declared themselves on one side or the other a rich harvest for their consideration.

It is in a discussion such as this that the trained eye and detailed knowledge of the systematic entomologist is of supreme value, and the weighty article by Mr. R. C. L. Perkins on the colour groups of Hawaiian wasps, and the paper by Colonel Manders on his temperature experiments on Danais and Hypolimnas in Colombo, will be read with much interest.

It is quite impossible in a short notice to do justice to the many articles of interest that the volumes contain, but special attention may be directed to the interesting address by Dr. Dixey, as president of the Entomological Society, on the effect of external influences on the germ plasm in insects, and the evidence it affords bearing on the theories of evolution, and to the essay by Mr. Guy Marshall on the limitations of the Müllerian hypothesis. To the morphologist, Prof. Poulton's memoir on the structure of the lepidopterous pupa, and Mr. Eltringham's account of the male genital armature of the species of the genus Acraea, and to the systematist Mr. Shelford's elaborate and beautifully illustrated memoirs on the Orthoptera, Mr. Eltringham's important contributions to our knowledge of the African species of the genus Acraea, Colonel Bingham's memoir on the Aculeate Hymenoptera and other shorter papers will prove to be of interest.

Prof. Poulton and his colleagues may be heartily congratulated on the extensive and important contribution to knowledge they have made during the period that is covered by these three handsome volumes.

S. J. H.

DR. MAWSON'S ANTARCTIC EXPEDITION.

DR. MAWSON has returned from the Antarctic to Australia, and readers of his message to the *Times*, recounting his wonderful escape after a month's march alone, when he had witnessed the death of two companions, will congratulate him on the courage and endurance which saved him from an end like theirs. The three were on a march of exploration south-eastward from the main base in Adélie Land, in November-January, 1912–13, when Lieutenant Ninnis fell with a loaded sledge into a crevasse. Dr. Mertz and Dr. Mawson, in the face of starvation owing to this disaster, returned to within one hundred miles of the base, when Mertz succumbed, and Mawson was only saved by the discovery of a *cache* of food left by a search party, after he had made a long and dreadful solitary journey.

Dr. Mawson's principal object was to explore that section of Antarctica which lies due south of Australia (Fig. 1). To the east of his own field of operations lies the region opened up by the work of Scott and Shackleton; to the west of the base established by his colleague, Mr. Frank Wild, a thousand miles distant in a direct line from his own, the German *Gauss* expedition was at work in 1902–03, and gave the name of Kaiser Wilhelm II. Land to its sphere of action. The intervening area was very little known; landings had not been previously made in either of the districts covered by Dr. Mawson and Mr. Wild, and the coast-line was only known—and that, as the present expedition has proved, by no means certainly—at a few points reported by expeditions made more than seventy years ago, by Balleny, by Dumont D'Urville, and by Wilkes.

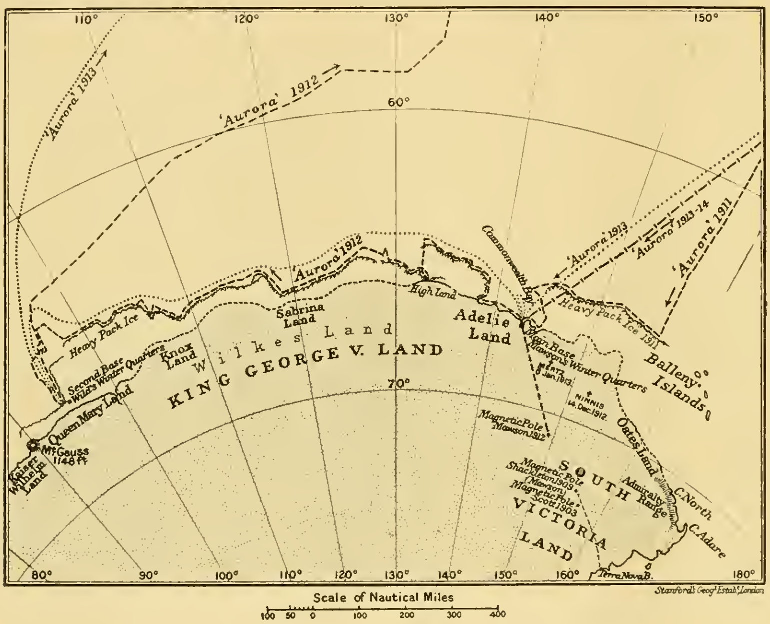


FIG. 1.—Field of operations of the Mawson Antarctic expedition.

The data are, of course, insufficient to attempt as yet any detailed estimate of the scientific value of the work of Dr. Mawson's expedition. But it must be substantial. We know something of it already from the reports of Mr. Wild and Captain J. K. Davis (who commanded the ship of the expedition), which they made on returning from the Antarctic last March.

The wireless telegraphic station established on Macquarie Island has already proved its worth, and may form the first step in a system of weather-forecasting, important not only to shipping in Australian waters, but to agriculturists and others in Australia. We hear of the discovery of minerals, including coal and copper. Exploratory journeys over the sea-ice and the continental plateau are stated to have covered 2400 miles from the main base and 800 miles from the western base. From the ship valuable results have been obtained by deep-sea dredging and other means, and the antarctic continental shelf has been traced through 55 degrees of longitude. It must also be remembered that the work of the general scientific programme has been continued at the main base through two complete years, though through one only at the western base.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Dr. E. J. Allen, Mr. R. Assheton, Mr. G. T. Bennett, Prof. R. H. Biffen, Dr. A. E. Boycott, Mr Clive Cuthbertson, Dr. H. H. Dale, Prof. A. S. Eddington, Prof. E. J. Garwood, Mr. T. H. Havelock, Dr. T. M. Lowry, Prof. D. Noël Paton, Mr. S. Ruhemann, Dr. S. W. J. Smith, and Dr. T. E. Stanton.

MR. J. DEWRANCE has presented the sum of 2000*l*. to the donation fund of the Royal Society. The income arising from this fund is used mainly for the promotion of experimental researches.

A YEAR ago announcement was made of a gift of 15,000*l*. to the Middlesex Hospital for the purpose of building an institute of pathology, a department greatly needed in order to raise the hospital to the standard required by modern scientific medicine. At the annual court of governors of the hospital on February 26, Prince Alexander of Teck announced that the donor was Sir John Bland-Sutton.

IN our issue of February 12 (p. 667) particulars were given of the conference of persons interested in the physical aspects of the study of the air, the earth, and the sea, to be held in Edinburgh next September. Sir John Murray is to be the president of the conference. We have since received information that arrangements are in progress for a Meteorological Congress to be held in Venice in the same month, and that meteorologists of all countries are to be invited to it. The president of the executive committee of this proposed congress is Prof. S. Urbani, director of the Patriarcal Meteorological Observatory, Venice.

THE London School of Tropical Medicine has sent an expedition to China to study the mode of dissemination of human diseases caused by trematode parasites, especially bilharziosis, and the relation of such diseases to those occurring in domestic animals. Investigations into ankylostomiasis will also be carried on. The members of the expedition are Dr. R. T. Leiper, helminthologist of the Tropical School, Surgeon E. L. Atkinson, R.N., and Mr. Cherry-Garrard. The two last-named were members of Scott's Antarctic Expedition, and the name of Surgeon Atkinson is familiar to the public as the leader of the search party which recovered the bodies of Capt. Scott and his companions. Surgeon Atkinson also made a large and important collection of Antarctic parasites, and since his return from the expedition he has been occupied in working out the helminths in collaboration with Dr. Leiper. Drawings of the helminths collected were exhibited by Dr. Leiper and Surgeon Atkinson at a recent scientific meeting of the Zoological Society. The collection of Antarctic Protozoan parasites still remains to be worked out.

THE recent review of the position of Army aviation in a statement to Parliament by the Secretary of State for War is interesting as showing the progress of aviation in England, and also the need for further improvement before aeroplanes can be regarded as having reached a satisfactory degree of development. Six years from the date of the first successful flights in Europe, it can be said that in the year just ended there were only six flying days on which flights by officers and men of the Royal Flying Corps did not take place. This is a significant indication of the rapidity of development of the science of aviation which is made still more noticeable by the statement that during this time journeys amounting to more than 100,000 miles were made without any loss of life. It appears that aeroplanes are being taken out in stronger and stronger winds, and a record of nearly seventy miles an hour stands to the credit of one of the officers of the Royal Flying Corps. In spite of such striking performances, it is clear that there is still much to be learnt. Colonel Seely pointed out the necessity for keeping 200 machines in being, so that 100 of them may be ready for use at a given time. In other words, at least half the life of a modern aeroplane is spent in the repair shop. This fact makes it necessary to attempt to raise the factor of safety of aeroplanes, and an inspection department has been organised by the War Office to deal with this aspect of the problems relating to aviation.

THE committee of the Lister Memorial Fund has commissioned Sir Thomas Brock, R.A., to execute a medallion portrait of the late Lord Lister, to be placed in Westminster Abbey. This will form part of the international memorial to commemorate the priceless services of Lord Lister to the cause of science and the alleviation of human suffering. Further subscriptions are required to enable the committee to carry out adequately the proposed scheme for the establishment of an International Lister Memorial Fund for the advancement of surgery. Among the subscriptions recently received are the following:—American Surgical Association, 135*l.*; received through Dr. W. W. Keen, of Philadelphia, 35*l.* (second donation); Committee of Surgeons in Holland, 125*l.*; faculty of medicine, University of Copenhagen, 109*l.*; members of the medical profession in Victoria (Australia), 91*l.*; Medical and Surgical Societies in Japan, 31*l.*; Union of Swedish Hospital Surgeons, 20*l.*; Newcastle-on-Tyne committee and members of the Clinical Society, 113*l.*; City of Belfast committee, 54*l.* Donations may be sent to the honorary treasurers of the fund (Lord Rothschild and Sir Watson Cheyne) at the Royal Society, Burlington House, W.

PROF. ERNST HAECKEL's eightieth birthday (February 16) has just been celebrated with natural enthusiasm at Jena. The heartiness of the congratulations from far and near must have delighted the veteran, who has had the great reward of seeing the successful development of the evolutionist doctrine of which he was an early champion. There were some noteworthy addresses summing up various aspects of his work, one of the weightiest being that delivered by Prof. Maurer, director of the Anatomical Institute, and published by Mr. Gustav Fischer, Jena. He refers to Haeckel's education and the influences of Leydig, Kölliker, and Virchow (then inclined to be an evolutionist), and still more of Johannes Müller, the "Origin of Species," and Gegenbaur. It was in the early days of his friendship with Gegenbaur that Haeckel wrote his monumental "Generelle Morphologie," in many ways the greatest of his works. We have become familiar with much of its teaching, *e.g.* that the individual development is essentially related to the racial evolution, or that classification is an attempt to discern a genealogical tree, and we are thus apt to forget what forceful new ideas these once were. Prof. Maurer directs attention to Haeckel's strong historical sense, so well expressed in the early chapters of "The Natural History of Creation," to the permanent influence that his radiolarian work (he described some 4000 new species) had throughout his life, to the extraordinary success of his educative expository writings, to his exceptional talent as an artist, to his unwavering consistency and courage, often expressed in polemical writing which gave little hint of the charm of his personality, and to the strenuousness with which he has realised the ever serious purpose of his life. Since an unfortunate accident a few years ago, Haeckel has not been able to go about, but it is delightful to hear that he is still youthful in spirit, able to follow the progress of science, and even to share in it. We would join in the congratulations which have been recently offered to him.

MR. W. CAMERON FORBES is about to start for Central and South America, for the purpose of collecting specimens of birds for the museum of Harvard University.

THE death is announced, in his seventy-sixth year, of Dr. L. Schöney, late professor of pathology and clinical microscopy in the New York Eclectic Medical College. He had made numerous contributions on botany and histology to scientific journals.

DR. R. K. DUNCAN, director of the Mellon Institute of Industrial Research, and professor of industrial chemistry at the University of Pittsburg, has died at the age of forty-five. He was a Canadian by birth, and was educated at the University of Toronto. After teaching science for several years in various American secondary schools, he was appointed in 1901 to the chair of chemistry in the Washington and Jefferson College. In 1906 he became professor of industrial chemistry at the University of Kansas, where he initiated a new scheme of industrial fellowships which has since grown to large proportions. His Pittsburg appointment dated from 1910. He discovered new processes for manufacturing glass and phosphorus.

He edited the "New Science Series," and was the author of "The New Knowledge," "The Chemistry of Commerce," and "Some Chemical Problems of To-day." Dr. Duncan was popularly known through his articles on radio-activity in *McClure's Magazine*, and on industrial chemistry in *Harper's*, for which he made special inquiries abroad.

Among the victims of the *Titanic* disaster in April, 1912, was Mr. H. Forbes Julian, whose work as a mining engineer, and for metallurgical science, was referred to appreciatively at the time in these columns (vol lxxxix, p. 325). On February 24 a memorial tablet erected by a committee which included the names of many distinguished men of science was unveiled to Mr. Julian in St. Mary Magdalene Church, Torquay, by the Ven. Archdeacon of Totnes, in the presence of a large congregation. The inscription on the tablet is as follows:—"Ad Majorem Dei Gloriam. This tablet is erected by a wide circle of friends in affectionate remembrance of Henry Forbes Julian, member of the Institution of Mining and Metallurgy, born Ascension Day, 9th May, 1861; married in this church 30th October, 1902; passed away 15th April, 1912. During the whole of his working life he laboured at the solution of metallurgical problems in three Continents, and both by his writings and practical skill exercised an influence which will long endure. He was amongst those who gave their lives for others in the disaster which befell the R.M.S. *Titanic*. This heroism and self-denial called forth admiration from the Throne to the cottage. 'Greater love hath no man than this, that a man lay down his life for his friends.'"

The duration of bright sunshine at Greenwich in February was 106 hours, which is exactly double the average of the past thirty years, and is the brightest February on record; the highest previous record for February was ninety-nine hours in 1899. In February this year at Greenwich there were twelve days with more than five hours' sunshine, whilst in July last year there were only seven days with more than five hours' sunshine. The total hours of bright sunshine in February are ten hours more than in the whole of July last year. At Kew the duration of bright sunshine in February was eighty-one hours, at South Kensington sixty-nine hours, and in the City, at Bunhill Row, 44 hours, the latter being ten times more than in January. The following gives the duration of bright sunshine at a few stations in England, chosen promiscuously from the reports of the Meteorological Office. For the several stations the duration was:—Dover, 119 hours; Hastings, 111 hours; Yarmouth, 108 hours; Margate, 106 hours (the same as at Greenwich); Brighton, 103 hours; Torquay, about 80 hours; Bath, 70 hours; Liverpool, 66 hours; and Buxton, 55 hours. The excess of sunshine in and round London is far more striking than in other parts of England.

The inaugural meeting of the Institution of Petroleum Technologists was held at the Royal Society of Arts on Tuesday, February 3. Sir Boverton Redwood, the president of the institution, who occupied the chair, said, in the course of his opening remarks, that the aims of the institution are to enable technologists engaged in the petroleum or shale oil industry to meet, correspond, and accumulate trustworthy information regarding the production or winning of petroleum and oil-shale, the conversion of the raw materials into manufactured products, and the characters and uses of these products, together with their transport and storage; and, in the second place, to promote the better education of persons desirous of becoming professional consulting petroleum technologists, engineers, geologists, or chemists, and to elevate the professional status of those employed in the industry by setting up a high standard of scientific and practical proficiency, and by insisting upon the observance of strict rules in regard to professional conduct.

At the thirty-sixth annual general meeting of the Institute of Chemistry, held on Monday, March 2, the president, Prof. Raphael Meldola, who was in the chair, referred, in the course of his address, to the endeavours of the institute to secure fuller recognition for the profession of chemistry. The council of the institute, in a memorandum submitted to the Royal Commission on the Civil Service, stated that the chemical staff in the department of the Chief Inspector at Woolwich Arsenal should be controlled by a chemist of the highest efficiency. The real expert whose knowledge and experience are of most value to the community is the highly trained man who has specialised in some particular field. Surely such a man is the most competent to control the work of any public department which is concerned with his own subject. Why, therefore, should there be this tendency to subordinate expert scientific service to non-expert control? While the medical service takes army "rank," the chemist, whose services are of equal importance, not only takes no "rank" at all, but is made responsible to superiors having no special knowledge of his subject. This state of affairs, rendering as it does the public service of chemists an unattractive career to the best talent in the profession, is fraught with danger to the future well-being of the country, and is a shortsighted policy which, in time of trouble, may well lead to disaster. Prof. Meldola then dealt at considerable length with the report of the conference of professors of chemistry, held under the auspices of the institute in October last, which was attended by professors from practically all the principal educational centres of the country, the institute thus providing an arena for the free discussion of the broad question of the education of professional chemists. Sir William Ramsay, in proposing a vote of thanks to the president for his address, endorsed the views which had been expressed with reference to placing men having no technical knowledge in the control of experts, and remarked on the absurdity of requiring them to sign reports only fully understood by the specialist.

Miss M. A. Murray discusses, in the February issue of *Man*, the evidence for the custom of killing the king in ancient Egypt, in connection with the Osiris cult, as explained by Dr. J. G. Frazer in "The Golden Bough." She interprets the name of Isis as Isé, "the throne-woman," and Osiris, or Usiri, "the occupier of the throne, the king." She notes that Arab legends of the ancient kings of Egypt mention the disappearance of two monarchs, and thus seem to preserve the tradition of the divine spirit leaving the world. The art evidence begins only from Roman times, and the ceremonial record is less conclusive, being connected with the obscure Sed festival, of which she offers a new explanation. It seems to be connected with a fertility cult. But the Egyptian evidence, though when the details are taken together, it is suggestive, is far from being so clear as the practice of king-killing among the Shilluks of Fashoda, which was fortunately recorded in time for its use by Dr. Frazer in the new edition of his great work.

THE January number of *Eugénique*, which is the monthly journal of the Société française d'Eugénique, is largely occupied by Dr. Saleeby's lecture on the progress of eugenics, which was delivered before the society on January 7. In the discussion which followed it, M. March, the head of the French Government Statistical Department, made some interesting observations on the relations between biometry and Mendelism. He pointed out that Mendel's laws themselves are statistical laws based on the theory of probabilities, while biometry is simply the application of statistical methods to biological problems. With regard to the controversy concerning the effect of alcoholism on the offspring, M. March condemns those as unscientific who criticise the results obtained by the Galton Laboratory, on the ground that they render weaker the struggle against alcoholism, and says further:—"Temperance societies know well the eternal objection made by peasants, 'Look at my neighbour; he is eighty years of age, in splendid health, and has always drunk.' On this point, as on all others, numerous observations, well conducted and well analysed, are the best means of reaching the truth."

FROM an article in the *Journal of Heredity*, vol. v., No. 2, we learn that, as the result of experiments conducted by Mr. Alexander Graham Bell in Nova Scotia, high feeding of ewes just before the autumn pairing season results in the production of a much higher percentage of female lambs than ordinary, the proportion of this sex in his flock being 72 per cent., whereas in those of neighbouring farmers there was a percentage of 88½ males.

THE first number of a new monthly journal devoted to microscopy has been issued. It is entitled *The Journal of Microscopy and Natural History Mirror*, and is edited by Mr. Edwards, the secretary of the Postal Microscopical Club, Reading. Its object is to foster the study of natural history with microscope and camera, and to help and instruct the amateur microscopist. The present number contains short articles on photomicrography, pond-life, mounting, and so on.

BULLETIN No. 36 of the Agricultural Research Institute, Pusa, India, contains a note by Major Holmes, on the McFadyean staining reaction for anthrax bacilli. This consists in staining under-fixed films with methylene-blue, by which procedure the bacilli are stained blue, and appear to be surrounded with a pale purple capsule. Major Holmes confirms the diagnostic value of this reaction, and makes the interesting observation that cattle in India rarely die of anthrax, even if inoculated with it.

IN *The American Naturalist* for February, Prof. W. E. Castle directs attention to the interest—from the point of view of Mendelian colour-inheritance—of two new colour-phases of the brown rat, respectively known to breeders as the pink-eyed yellow, fawn, or cream, and the black-eyed yellow, fawn, or cream. The former seems to have first appeared about 1910 or 1911, while the originator of the second strain, as we learn from an appendix to the paper, was brought to Liverpool by a ship in 1912. Their special interest lies in the fact that yellow phases—due to the suppression of black and brown pigment—has hitherto been unknown in this species.

A REMARKABLE instance of the needless multiplication of technical names in zoology has recently occurred in the case of Grévy's zebra. Some years ago Mr. R. I. Pocock pointed out that this species was so markedly distinct from other Equidæ as to be worthy of subgeneric separation, although he did not suggest a new subgeneric title. In 1912, Dr. Max Hilzheimer (*Abh. Senckenberg Ges.*, vol. xxi., p. 85), proposed for this species the subgeneric name, Megacephalon, which is preoccupied (1846) by a well-known genus of birds. In the same year Mr. N. Heller (Smithsonian Misc. Collect., vol. lx., No. 8, p. 1), apparently without knowledge of Dr. Hilzheimer's work, proposed the name Dolichohippus, in a generic sense. Unaware of this, Dr. A. Griffini, in an article on zebras and quaggas, orginally published in vol. iv. of *Natura* (Padua), but of which separately paged reprints have just reached this country, suggests the name, Ludolphozecora (from "Zecora," the designation by which Ludolphus alluded to the species), to replace the preoccupied Megacephalon.

A COPY has been received from Washington of the report of the secretary of the Smithsonian Institution for the year ending June 30, 1913. We learn from it that a plan has been formulated and some progress has been made in certain lines of field work for a geological survey of Panama, under the joint auspices of the Isthmian Canal Commission, the United States Geological Survey, and the Smithsonian Institution, and a grant has been made from the institution's funds toward the expenses of such investigation. The general plan of the survey comprises a systematic study of the physiography, stratigraphy, and structural geology, geological history and correlation, mineral resources (including coal, oil, and other fields), petrography and palæontology of the canal zone, and of as much of the adjacent areas of the isthmian region as is feasible. The biological survey of the canal zone, organised by the institution in 1910, was brought to a close during the year so far as field work was concerned, and some of the results have been referred to in these columns.

IT has long been recognised that a necessity exists for the improvement of the important medicinal plants.

One of the first steps necessary to inaugurate such work is to determine the variation of the active constituents in individual plants and the extent to which such variation is influenced, if at all, by the various factors affecting the growth and cultivation of the plant. Investigations in this direction have been carried out with belladonna recently, and are reported by Mr. A. F. Sievers to the new *Journal of Agricultural Research* (vol. i., No. 2). The variation in the alkaloidal content of the leaves throughout the season was determined, but no relation appeared to exist between the physical appearance of the plant and the amount of alkaloid present. It was found advisable, however, to aim for a greater yield of young leaves of rather lower content than to delay picking until higher content and lower aggregate yield is only obtainable. The plants experimented with show, among themselves, a very great variation in alkaloidal content, separation into two groups being possible, the content of the one being twice that of the other. By selection and cultural means the total production of alkaloids ought to be capable of great increase.

A REPORT by Dr. J. V. Eyre on the possibility of reviving the flax industry in Great Britain has been published as a supplement to the Journal of the Board of Agriculture. A brief historical review of the subject is given, followed by a discussion of the effect of soil, manure, climate, and cultivation, on the crop. Harvesting, retting, and subsequent treatment are described in detail, and the whole forms a valuable guide to the condition of the industry in this country. The crop has many advantages to recommend its more general adoption, especially by the small holder, provided that efforts are directed to the preparation of high grades of fibre. There certainly is reason for believing that the judicious revival of the industry, managed according to improved methods, would be productive of benefit to British agriculture, and would induce people to find regular employment in rural districts by creating a demand for skilled labour.

THE indexes to the Physics and Electrical Engineering volumes of *Science Abstracts* for 1912 have reached us. The former volume extends to 750 pages, with more than 2000 abstracts, and the latter to 670 pages, with nearly 1300 abstracts. The greater average length of the electrical engineering abstracts appears due to descriptions of installations and appliances. The initials of the abstractor at the foot of each abstract and a reference to the list of abstractors at the beginning of each volume, show that in nearly all cases the abstract has been written by one who has a special knowledge of the subject, and so long as this characteristic of Science Abstracts is maintained, so long will it continue to enjoy the confidence of those who make use of it. The indexing appears adequate, the name-index in the physics volume covering thirty and the subject-index fifty-six pages.

WE have received from the Reichsanstalt a number of memoirs dealing with the work done there, which have appeared in recent numbers of the *Annalen der Physik*, the *Zeitschrift für Instrumentenkunde*, and other periodicals. One by Dr. F. Henning deals with new determinations of the boiling points of oxygen and carbonic acid, and the freezing points of mercury and other liquids. The temperatures were measured by five platinum resistance thermometers, which had been previously compared with the constant volume hydrogen thermometer. The static method was used for the boiling points. The results are:—Normal boiling points: Oxygen, -182.97°, carbonic acid, -78.53; freezing points: mercury, -38.89, ethyl ether, -123.6; melting points, carbon bisulphide, -112.0, chloroform, -63.7, chlorobenzene, -45.5° C. Others by Drs. W. Jaeger and H. von Steinwehr deal with comparisons of various copies of the ohm amongst each other and with the mercury standard, and with current measurements with the silver voltameter. They show that the German ohm agrees with the English to within a few hundred thousandths, and that the electromotive force of a Weston cell is 1.01829 volt at 20° C.

THE White Star liner *Britannic* was launched from Messrs. Harland and Wolff's yard at Belfast on February 26. The following particulars of this vessel are taken from illustrated articles in *Engineering* and the *Engineer* for February 27. The principal dimensions are:—Length over all, about 900 ft.; breadth, extreme, about 94 ft.; depth moulded, 64 ft. 3 in.; total height from keel to navigating bridge, 104 ft. 6 in.; gross tonnage, about 50,000 tons; propelling machinery—reciprocating engines of 32,000 i.h.p. exhausting into a Parsons low-pressure turbine of 18,000 shaft-horse-power; sea speed, 21 knots. Accommodation is provided for 2,579 passengers and 950 crew, a total of 3,529 persons. The vessel is probably the strongest passenger ship structurally constructed up to the present time, and is so amply divided by longitudinal and transverse bulkheads that her destruction by any dangers of the sea is incredible. The double system of construction is carried up the sides of the vessel to a considerable distance above the load water line, and the walls are literally honeycombed with compartments. None of these compartments will be opened on the inner side during a voyage. There are sixteen transverse bulkheads, five of which extend to a height of more than 40 ft. above the deepest load line, and all the others are carried to a height of more than 21 ft. above the water line. The bulkheads are of very heavy construction. The lifeboat arrangements will meet fully the requirements of the recent International Convention.

MESSRS. FLATTERS AND GARNETT, LTD., have issued a supplementary catalogue of the lantern slides added to their stock during 1913. Among these additions are a large number of photographs of British wild flowers and a series of slides illustrating the commercial geography of the north of England, arranged by Dr. A. Wilmore.

AMONG recent additions made by Messrs. Jack to their "People's Books" are "Applications of Electricity for Non-Technical Readers," by Mr. A. Ogilvie, and "Wild Flowers," by Mr. M. Skene. The first book explains in simple language, which takes no previous knowledge of the science for granted, the elementary facts upon which the chief everyday applications of electricity are based. The volume on wild flowers contains two hundred black and white illustrations of common flowers, and descriptions of these and others arranged in chapters according to their colours. Thus we have chapters on white, yellow, red, blue, flowers, and so on. The price of each volume in the series is 6*d.* net.

OUR ASTRONOMICAL COLUMN.

STARS WITH VARIABLE RADIAL VELOCITIES.—In the *Astrophysical Journal* for January (vol. xxxix., No. 1, p. 39) Mr. Oliver J. Lee contributes numerous measures of variable radial velocities of stars determined in the course of measuring Bruce spectrograms. Of the twenty-eight stars to which reference is made, eighteen have been previously announced as spectroscopic binaries, but the remaining ten are new. The following table is abstracted from the information given in the paper, and indicates the star in question, position, magnitude, and class :—

Star	R.A. h. m.	Dec. ° ′	Mag.	Class
89 *f* Piscium	1 13	+ 3 5	5·3	A_2
73 ξ^2 Ceti	2 23	+ 8 1	4·3	A
125 Tauri	5 34	+25 50	5·0	B_3
40 Aurigæ	6 0	+38 30	5·3	A
24 Can. Ven.	13 30	+49 32	4·6	A_3
33 Boötis	14 35	+44 50	5·4	A
27 β Libræ	15 12	− 9 1	2·7	B_8
BD 25°4165	20 11	+25 17	4·8	B_3
33 *i* Aquarii	22 1	−14 21	4·4	B_8
18 λ Piscium	23 37	+ 1 14	4·6	A_5

SUN-SPOTS: THEIR INTERNAL MOTION AND SHORT-PERIOD VARIATIONS.—The fifth volume of the *Publikationen der Sternwarte des Eidg. Polytechnikums zu Zurich* contains two contributions, the first by William Brunner, on the investigation of the internal motions in sun-spots, and the second by Elsa Frenkel, on short-period variations in the frequency of sun-spots. The former is a detailed research, carried out in a systematic manner, on the internal motions, chiefly divergent. The chief result leads the author to associate this divergent motion with the origin and development phases of spot groups. The data employed were those of the period between January 1, 1887, and January 1, 1905, and were the result of observations made with the refractor of the Zurich Observatory. Numerous plates accompany the text. The second paper involves the discussion of the Zurich observations made during the period 1876–1911. Readers must refer to the original publication for the detailed account of the research, but the chief conclusions may be stated briefly as follows. The author finds a probable period of 200 days, but this is not apparent during the last three eleven-year periods, when the spot activity went below a certain limit. The length is not constant, but varies about a mean value of 150 to 200 days. The ordinate of the periodigram is about 100 times smaller than the eleven-year period, and the amplitude about ten times smaller than that of the eleven-year period. Another period of 68·5 days was indicated, but this will be investigated again at a later date. Attention is directed to the lengths of these two periods, namely 200 and 68·5 days, and the sidereal times of revolution of the two inner planets, namely Mercury, 87·9 days, and Venus, 224·7 days. The text is accompanied by a large number of plates showing the observed and smoothed curves of the daily relative numbers.

DETERMINATIONS OF GRAVITY IN EGYPT AND THE SUDAN.—Survey Department Paper No. 18 (Cairo) contains details of the determination of "g" at eight stations in Egypt and the Sudan, carried out by Mr. P. A. Curry, in connection with the geodetic survey. Almost the whole of the observations and the whole of the computational work have been done by Mr. Curry himself. The stations range from Helwân to Khartoum, nearly 15° of latitude, and the height above sea-level varies from 42 to 383 metres, but the topographical correction has been *nil* for each of the stations. The Stuckrath pendulum apparatus employed was borrowed from the South Kensington Museum, where it had been deposited after the return of Captain Scott's first Antarctic Expedition. This instrument provides essentially for the determination of the time of oscillation of each of a number of invariable pendulums swinging in separate cells of a vacuum chamber. Besides the correction due to the rate of the chronometer, *four* instrumental corrections need to be determined, namely, for temperature, pressure, amplitude of vibration, and flexure of pillar. Kew was taken as the base and Helwân was made the primary Egyptian station. 981·201 cm./sec.^{2} (based on the Potsdam system) was adopted as the value of "g" at Kew, and from a discussion of *ninety-eight* separate determinations 979·295 cm./sec.^{2} was obtained as the final value of this constant at Helwân, the probable error being ±0·0027. The values obtained for each of the stations have been reduced to sea-level and compared with the theoretical value for the latitude of the station given by Helmert's formula (1901). Remarkably close agreement obtains, ranging only between +0·009 and −0·013, whence it is concluded that there is nothing very abnormal about the values of gravity at these eight stations.

THE COBAR COPPER FIELD.

COBAR, on the western plains of New South Wales, 464 miles by railway from Sydney, is one of the most important, though not most profitable, of the copper fields in Australia; it yielded 6500 tons of copper in 1911, and has produced more than 90,000 tons since its discovery in 1869. The development of the field was hampered by its remote position and its semi-arid climate, for with a rainfall of only 15 in. it is surrounded in dry seasons by a wide, waterless tract. In its early days, however, the export of ore was once stopped by floods, which inundated the plains beside the Darling River for a width of fifty miles. Another trouble was an invasion in 1890 by millions of rabbits, which destroyed the vegetation by devouring the shrubs and ring-barking the trees.

The rocks of the mining field belong to three main divisions.[1] The oldest is the Cobar Series, which comprises semi-metamorphic sediments of perhaps pre-Silurian age; its most important member consists of thick beds of chert, which Mr. Andrews regards as a recrystallised organic precipitate. The account of these beds suggests their resemblance to the Heathcotian Series of Victoria, which are of Cambrian age. The middle division, the Mallee Tank beds, includes fossiliferous limestones, and its age is certainly Silurian. The upper division is Devonian, and includes a varied series of quartzites, shales, and claystones. The rocks of all three divisions have been disturbed by intense compression due to earth movements at the beginning and at the end of the Devonian period. The pressure was so powerful that the minimum dip observed in the Silurian rocks is 30°, and the Devonian

[1] E. C. Andrews: Report on the Cobar Copper and Gold-field. Part i. (Department of Mines, New South Wales, Mineral Resources, No. 17). 1913, xi. Pp. 207+xlv plates+19 maps in separate portfolio.

rocks have been overthrust and the pebbles in the conglomerates sheared and shattered. One striking feature of this mining field is the rarity of igneous rocks; they are represented only by two small pipes of orthoclase-porphyry, which appear to have no connection with the ores. The mineral deposits are attributed by Mr. Andrews to the post-Devonian earth movements. Certain features suggested that they might be bedded ores; but, as so often happened with ores so regarded, more detailed study has shown that they are of secondary origin. They have been formed in connection with great fault movements and by the replacement of slate by sulphides. This conclusion is definitely established by Mr. Andrews's excellent monograph, which includes a detailed account of the geology, history, and mines of this field.

The chief copper-bearing mineral is chalcopyrite, and it is associated with pyrrhotite, ordinary iron pyrites, and a silicate of iron, which is identified by Mr. Card as ekmannite. The ores have undergone great secondary concentration, which Mr. Andrews attributes, with great probability, to the arid climate and prolonged stability of the field. Ever since the post-Devonian disturbances the country does not appear to have been affected by any earth movements except some minor oscillations; and the level has only been lowered by denudation about 200 ft., according to Mr. Andrews's estimate, during all later geological times. The chemical analyses are of especial value owing to the determination of an unusually large number of constituents. The description of the field is illustrated by a series of plates, some of which are coloured, showing the intimate structure of the ores and the relation of their constituent minerals; and the memoir is accompanied by a portfolio of maps and mine plans. All the separate mines are described in detail. The discussion of the ores shows wide acquaintance with the recent literature on the subject, and the author's conclusions command respect owing to the obvious care and accuracy with which the work has been conducted. The author's view that magnetite is formed only under conditions of great heat is perhaps too general, and the remark that the Murray River enters the sea near Adelaide might mislead a reader who is not used to judging proximity by Australian standards of distance. J. W. G.

PUBLIC HEALTH.

WE have received the report, for 1912–13, of the Medical Officer of the Local Government Board. There is no greater authority than Dr. Newsholme on all matters of public health, and every page of his report should be read by all who care for our national health and efficiency. Among many other subjects of interest, he directs attention to the practical problems of "typhoid carriers," the present rather threatening facts of cerebro-spinal fever and poliomyelitis, and the contrast of the steady decline of scarlet fever, diphtheria, and typhoid, with the obduracy of measles. Of smallpox, 121 cases were notified during 1912 in England and Wales, but only nine died. It may be worth noting that, in one household, three small children died, whose parents had declined vaccination for them.

Tuberculosis, naturally, occupies a great part of Dr. Newsholme's report. For, beside the grant of some 60,000*l*. annually for research, the year 1912–13, as Dr. Newsholme says, "will always stand out as a landmark in the history of the administrative control of tuberculosis. During this year the Board made all forms of tuberculosis compulsorily notifiable; the provisions of the National Insurance Act, 1911, as to sanatorium benefit, came into operation; the capital grant under the Finance Act, 1911, of $1\frac{1}{2}$ millions sterling for the provision of institutions for the treatment of tuberculosis in the United Kingdom, became available; and the important offer was made by the Treasury to defray one-half of the annual cost of schemes for the treatment of tuberculosis, proposed by local authorities and approved by the Local Government Board, which are available for the entire population, after deducting any contribution received from the local insurance committee or from other sources." Other points of interest, in Dr. Newsholme's report, touch the work of the Medical Department of the Board; the work of the International Health Office, the International Sanitary Conference in Paris, 1912, and other services rendered to the public by the Medical Department.

After Dr. Newsholme's report, come Dr. Bruce Low's admirable and authoritative monographs on plague, cholera, and yellow fever, giving a full account of the incidence on the world, during 1911 and 1912, of these three scourges. Then comes a great number of shorter reports. Altogether, this volume is of singular value to all who are concerned—and who is not?—with the health and safeguarding of our country.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

A. and C. Black.—The World's Cotton Crops, Prof. J. A. Todd, illustrated. *Crosby Lockwood and Son.*—Agriculture: Extensive and Intensive, Prof. J. Wrightson, in conjunction with J. C. Newsham.

ANTHROPOLOGY AND ARCHÆOLOGY.

John Bale, Sons and Danielsson, Ltd.—Hausa Folk-Tales, Major A. J. N. Tremearne. *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King, illustrated, vol. ii., A History of Babylon from the Foundation of the Monarchy to the Persian Conquest, vol. iii., A History of Assyria from the Earliest Period to the Fall of Nineveh. *Constable and Co., Ltd.*—Amulets, Prof. W. M. Flinders Petrie, F.R.S., illustrated; Kinship and Social Organisation, Dr. W. H. R. Rivers, F.R.S. *Macmillan and Co., Ltd.*—Knossian Atlas, edited by Sir A. J. Evans, F.R.S., vol. i., The Wall Paintings, including coloured lithographic plates i.-xiii., from drawings by E. Gilliéron, with short descriptive sketch by the editor (to which are appended Lumière illustrations), and Notes on the Technique of the Frescoes by N. Heaton; The Nine Minoan Periods, a Summary Sketch of the Characteristic Stages of Cretan Civilization, from the Close of the Neolithic to the Beginning of the Iron Age, Sir A. J. Evans, F.R.S., illustrated; The Eastern Libyans, O. Bates, illustrated; Marriage Ceremonies in Morocco, Prof. E. Westermarck; The Native Tribes of the Northern Territory of Australia, Prof. W. B. Spencer, C.M.G., F.R.S., illustrated. *The Medici Society, Ltd.*—Mexican Archæology: An Introduction to the Archæology of the Mexican and Mayan Civilizations of Pre-Spanish America, Thomas A. Joyce, illustrated. *Methuen and Co., Ltd.*—The Nomads of the Balkans, A. J. B. Wace and M. S. Thompson, illustrated. *Oxford University Press.*—Contributions to Anthropology: vol. i., Coos Texts, J. Frachtenberg, vol. ii., The Ethnology of the Salish Tribes, J. A. Teit. *G. P. Putnam's Sons.*—The Folk-Ballads of Southern Europe, S. Jewett. *Williams and Norgate.*—The Antiquity of Man, Prof. A. Keith, F.R.S.

BIOLOGY.

F. Alcan (Paris).—Transformisme et Créationisme, Prof. J. L. de Lanessan. *D. Appleton and Co.*—Plant Breeding, J. M. Coulter. *A. and C. Black.*—Wild Life in the Woods and Streams, C. A. Palmer, illustrated; Common British Beetles, Rev. C. A. Hall, illustrated (Peeps at Nature Series). *Cambridge University Press.*—The Cambridge British Flora, Dr. C. E. Moss, assisted by specialists in certain genera, illustrated, vol. ii., The Earlier Dicotyledonous Families; The Philosophy of Biology, J. Johnstone; Bird Studies, W. P. Westell (Cambridge Nature Study Series); Pond Problems, E. E. Unwin (Cambridge Nature Study Series); The Annals of the Bolus Herbarium, vol. i., part 1, edited by Dr. H. H. W. Pearson. *Cassell and Co., Ltd.*—The Progress of Eugenics, Dr. C. W. Saleeby; Rock Gardening for Amateurs, H. H. Thomas, illustrated; Wild Flowers as They Grow, H. E. Corke and G. C. Nuttall, illustrated, Series vi. and vii.; Dogs and All About Them, R. Leighton, illustrated. *J. and A. Churchill.*—The Horticultural Record, R. Cory, illustrated. *J. M. Dent and Sons, Ltd.*—A History of Botany, Prof. J. R. Green, F.R.S. *Duckworth and Co.*—Glossary of Botanical Terms, Jackson, new edition. *W. Engelmann (Leipzig).*—Die Vegetation der Erde, edited by Profs. A. Engler and O. Drude, Band ix., A. Engler, Die Pflanzenwelt Afrikas insbesondere seiner tropischen Gebiete, Band iii., Charakterpflanzen Afrikas II., Archichlamydeen, Dikotyledoneen, Angiospermen, Heft. 1. *G. Fischer (Jena).*—Die Entstehung der Pflanzengallen, Prof. W. Magnus, illustrated; Tafeln zum Vergleiche der Entstehung der Wirbeltierembryonen, Prof. A. Greil. *W. Heinemann.*—Animal Life in Africa, Major Stevenson-Hamilton, four parts, illustrated, part i., Carnivora. *H. Holt and Co. (New York).*—Essentials of College Botany, Profs. C. E. Bessey and E. A. Bessey, eighth edition, entirely revised and rewritten of Bessey's Essentials of Botany; Students' Handbook of Botany, F. L. Sargent; General Zoology, Prof. E. G. Conklin; Economic Zoology and Entomology, Prof. V. L. Kellogg and R. W. Doane. *Hutchinson and Co.*—Insect Artisans and their Work, E. Step, illustrated. *C. H. Kelly.*—Sea-Side Wonders, and How to Identify Them, S. N. Sedgwick, illustrated. *Longmans and Co.*—Flowering Plants of the Riviera, H. S. Thompson, with an introduction on Riviera Vegetation, by A. G. Tansley, illustrated. *Macmillan and Co., Ltd.*—The History and Theory of Vitalism, Prof. H. Driesch, authorised translation by C. K. Ogden, revised throughout and in part rewritten by the author for the English edition; The Problem of Individuality, lectures delivered before the University of London, Prof. H. Driesch; A Treatise on Embryology, edited by W. Heape, F.R.S., vol. i., Invertebrata, Prof. E. W. MacBride, F.R.S., illustrated; Physiological Plant Anatomy, Prof. G. Haberlandt, translated by J. M. F. Drummond, illustrated; Cocoa, Dr. C. J. J. van Hall, illustrated. *Methuen and Co., Ltd.*—Diversions of a Naturalist, Sir E. Ray Lankester, K.C.B., F.R.S., illustrated; Some Minute Animal Parasites, Dr. H. B. Fantham and Dr. A. Porter, illustrated; Spade-Craft, H. A. Day. *John Murray.*—Trees and Shrubs Hardy in the British Isles, W. J. Bean, 2 vols., illustrated; Concerning Animals and other Matters, E. H. Aitken, with a memoir of the author, illustrated; The Genus Rosa, Ellen Willmott, illustrated, concluding part. *Quelle and Meyer (Leipzig).*—Fauna von Deutschland, edited by Dr. P. Brohmer, illustrated; Lehrbuch der allgem. Botanik, by R. Heuer, illustrated; Leitfaden für biolog. Schülerübungen, by Dr. R. Rein, illustrated; Biologische Beobachtungs-aufgaben, by Dr. L. Spilger, illustrated; Garten und Landwirtschaft, Prof. E. Hahn, Die Süsswasserflora, by Prof. H. Glück, illustrated. *Williams and Norgate.*—All About Leaves, the late F. G. Heath.

CHEMISTRY.

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ENGINEERING.

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GEOGRAPHY AND TRAVEL.

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GEOLOGY.

Cambridge University Press.—Coal-Mining, T. C. Cantrill (Cambridge Manuals). *H. Holt and Co.* (*New York*).—Geology: Briefer Course, Profs. T. C. Chamberlin and R. D. Salisbury. *Macmillan and Co., Ltd.*—The Quaternary Ice Age, W. B. Wright, illustrated. *T. Murby and Co.*—Minerals and the Microscope, H. G. Smith, illustrated. *Quelle and Meyer* (*Leipzig*).—Geologische Wandkarte Deutschlands, Prof. J. Walther.

MATHEMATICAL AND PHYSICAL SCIENCE.

F. Alcan (*Paris*).—Le Hasard, Prof. E. Borel; Henri Poincaré: L'œuvre scientifique—L'œuvre philosophique, Profs. V. Volterra, J. Hadamard, Langevin, and P. Boutroux. *A. and C. Black.*—A First Book of Experimental Science for Girls: The House: Hydrostatics and Heat, Mrs. Jessie White. *Cambridge University Press.*—The Sun, Prof. R. A. Sampson (Cambridge Manuals); Photo-Electricity, Dr. A. Ll. Hughes (Cambridge Physical Series). *J. and A. Churchill.*—Molecular Physics, J. A. Crowther, illustrated. *W. Engelmann* (*Leipzig*).—Kristallberechnung und Kristallzeichnung, Dr. B. Gossner, illustrated; Elemente der Theorie der Kristallstruktur, Dr. S. Kreutz, illustrated. *G. Fischer* (*Jena*).—Photographisches Wörterverzeichnis in fünf Sprachen: Ido, Deutsch, Englisch, Französisch und Italienisch, Prof. L. v. Pfaundler. *Longmans and Co.*—Flying: Some Practical Experiences, G. Hamel and C. C. Turner, J. E. Adler will contribute a chapter on the Physiological and Medical Aspects of Aviation, and the Hon. G. Marconi on Wireless Telegraphy, and there will be other special contributions, illustrated; Flight without Formulæ: Simples Discussions on the Mechanics of the Aeroplane, Commander Duchene, translated from the French by J. H. Ledeboer, illustrated; The Teaching of Algebra (including the Elements of Trigonometry), Dr. T. P. Nunn; The Groundwork of Arithmetic, M. Punnett; Exercises in Arithmetic, M. Punnett, Books I., II., III.; The Teaching of Geometry, G. E. St. L. Carson; Slide-Rule Notes, Col. H. C. Dunlop and C. S. Jackson; Projective Geometry, G. B. Mathews, F.R.S.; Examples in Differential and Integral Calculus, C. S. Jackson and S. de J. Lenfesty; Non-Euclidian Geometry, Dr. H. S. Carslaw. *Macmillan and Ct., Ltd.*—The Theory of Relativity, Dr. L. Silberstein. *Methuen and Co., Ltd.*—The Complete Photographer, R. C. Bayley, illustrated, new edition; Practical Applied Physics, H. Stanley; Preliminary Practical Science, H. Stanley. *G. P. Putnam's Sons.*—The Call of the Stars, Dr. J. R. Kippax, illustrated; Sun Lore, W. T. Olcott, illustrated. *G. Routledge and Sons, Ltd.*—Photography in Colours, Dr. G. L. Johnson, illustrated, new edition *The S.P.C.K.*—A Voyage Through Space, Prof. H. H. Turner, F.R.S.

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John Bale, Sons, and Danielsson, Ltd.—Renal Diagnosis in Medicine and Surgery, Dr. V. Blum, translated by W. B. Christopherson; Acute General Miliary Tuberculosis, Prof. G. Cornet, translated by Dr. F. S. Tinker; Tropical Medicine and Hygiene, Dr. C. W. Daniels, with a chapter on Snakes by A. Alcock, part ii., Diseases Due to the Metazoa, new edition; Defensive Ferments of the Animal Organism, Prof. E. Abderhalden, translated by Dr. J. O. Gavronsky, third edition; Lehrbuch der Localanæsthesie, Hirschel, translated; Die Pathologie und Therapie der plötzlich das Leben gefährdeten Krankheitszustände, Lenzmann, translated; Lehrbuch der Tracheo-Bronchoskopie, Mann, translated; Defective Children, edited by Dr. Kelynack. *Cambridge University Press.*—The Respiratory Function of the Blood, J. Barcroft; Isolation Hospitals, Dr. H. F. Parsons (Cambridge Public Health Series). *W. Engelmann* (*Leipzig*).—Die Diagnostik mittels Röntgenstrahlen in der inneren Medizen und den Grenzgebieten, Prof. E. Grunmach, illustrated; Monographien: Anatomische und entwicklungsgeschichtliche, edited by Prof. W. Roux, 3 Heft, Remarques sur le mécanisme du modelage des embryons humains, Courbes embryotectoniques, Dr. E. Bujard, illustrated. *A. and C. Black.*—Radiography, X-Ray Therapeutics, and Radium Therapy, Dr. R. Knox, illustrated; Tuberculosis of Bones and Joints in Children, Dr. J. Fraser, illustrated; Black's Medical Dictionary, edited by Dr. J. D. Comrie, illustrated. *Cassell and Co., Ltd.*—Hygiene and Sanitation Manual, Lieut.-Col. S. G. Moores, illustrated; A System of Surgery, edited by Drs. C. C. Choyce and J. M. Beattie, illustrated, vol. iii. (British Red Cross Society Manuals). *J. and A. Churchill.*—A Manual of Dental Anatomy: Human and Comparative, C. S. Tomes, F.R.S., new edition, edited by Dr. H. W. Marett Tims and A. Hopewell-Smith, illustrated. *Constable and Co., Ltd.*—A Way of Life, Sir W. Osler, Bart., F.R.S. *G. Fischer* (*Jena*).—Diätetische Behandlung innerer Krankheiten, Dr. J. Grober. *W. Heinemann.*—Ophthalmoscopic Diagnosis, Dr. C. Adam, translated by Dr. M. L. Foster, illustrated; Local Anæsthesia, Dr. A. Schlesinger, translated by F. S. Arnold, illustrated; Affections of the Orbit and Accessory Cavities, Dr. C. R. Holmes, illustrated; Examination and Refraction of the Eye and Eye-strain, Dr. W. L. Pyle, illustrated; Medical Ophthalmology, Dr. A. Knapp, illustrated; Ophthalmic Surgery, Dr. J. Meller, illustrated. *H. Holt and Co.* (*New York*).—The Nervous System, R. P. Angier. *T. C. and E. C. Jack.*—The Modern Family Doctor. *H. K. Lewis.*—Industrial Lead Poisoning, Sir T. Oliver; Æquanimitas, Sir W. Osler, Bart., F.R.S., new edition; Anæsthetics, Dr. D. Buxton, new edition; The Ileo-Cæcal Valve, Dr. A. H. Rutherford; The Value of Tuberculin in the Treatment of Pulmonary Tuberculosis, the Medical Staff of the King Edward VII. Sanitorium, Midhurst; Health: A Course of Lectures based on the Syllabus of the London County Council, Dr. M. M. Burgess, illustrated. *Longmans and Co.*—Spectrum Analysis Applied to Biology and Medicine, Dr. C. A. Macmunn. *Macmillan and Co., Ltd.*—Diseases of the Arteries and Angina Pectoris, Sir T. Clifford Allbutt, K.C.B., F.R.S., two vols. *John Murray.*—Therapeutics of the Circulation, Sir T. Lauder Brunton, Bart., F.R.S., illustrated, new edition. *Oxford University Press.*—Plague and Pestilence in Literature and Art, R. Crawfurd, illustrated; Case Studies of Mentally and Morally Abnormal Types, W. Healy; The Evolution of Modern Medicine, Sir W. Osler, Bart., F.R.S. *G. P. Putnam's Sons.*—A Text-Book of Anatomy and Physiology for Nurses, A. E. Pope, illustrated.

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MISCELLLANEOUS.

F. Alcan (Paris).—L'éducation de l'Effort: Psychologie, Physiologie, Prof. G. Demeny. *A. and C. Black.*—Salmon-Flies: How to Tie Them, Choose Them, and Use Them, Dr. T. E. Pryce-Tannatt, illustrated; The Construction of Mortality and Sickness ables, W. P. Elderton and R. C. Fippard. *Cambridge University Press.*—Know Your Own Mind, W. Glover. *Cassell and Co., Ltd.*—Wonders of Land and Sea, Edited by G. Williams, illustrated, vol. i. *Constable and Co., Ltd.*—Philosophies Ancient and Modern, W. James and H. V. Knox. *W. Engelmann (Leipzig).*—Arbeiten zur Entwicklungspsychologie, edited by Prof. F. Krueger, Band i., Heft 1, Ueber Entwicklungspsychologie, Prof. F. Krueger, Band i., Heft 2, Ueber die Vorstellungen der Tiere, Dr. H. Volkelt; Gibt es denkende Tiere? Dr. S. von Máday. *Hutchinson and Co.*—Aviation, Lieut. M. Calderara, illustrated. *Longmans and Co.*—Education and Psychology, M. West. *Macmillan and Co., Ltd.*—The History of Greek Philosophy, Prof. J. Burnet, vol. i.; From Thales to Plato; An Introduction to Logic from the Standpoint of Education, L. J. Russell. *T. Murby and Co.*—The Mind at Work: A Textbook of Applied Psychology, edited by G. Rhodes. *G. P. Putnam's Sons.*—Glimpses of the Cosmos: A Mental Autobiography, Dr. L. F. Ward, 12 vols., vol. i., Adolescence to Manhood, Period 1858–1871, Age 16–30, vol. ii., Scientific Career Inaugurated, vol. iii., Dynamic Sociology.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year tenable for two years is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications should be sent to the master of Emmanuel not later than September 24.

It is proposed to confer the following honorary degrees on June 9, on the occasion of the opening of the new physiological laboratory:—Doctor of Law: Prince Arthur of Connaught, Viscount Esher, Baron Moulton of Bank, and Col. S. M. Benson; Doctor of Science: Sir William Osler, Bart., Sir David Ferrier, Sir Edward A. Schäfer, and Prof. E. H. Starling.

Dr. Norman Moore has been appointed to the office of reader on Sir Robert Rede's foundation for the present year.

Mr. J. M. Wordie has been appointed demonstrator of petrology.

SHEFFIELD.—Mr. L. Southerns has been appointed assistant lecturer and demonstrator in physics, in succession to Dr. R. T. Beatty, resigned; and Mr. A. Pringle Jameson has been appointed assistant lecturer and demonstrator in zoology, in succession to Mr. T. J. Evans, resigned.

MR. J. ADAMS, assistant in botany in the Royal College of Science, Dublin, has recently been appointed to a position under the Canadian Government.

LORD CHELMSFORD will present prizes and certificates to students of evening classes and day college at the South-Western Polytechnic Institute, Chelsea, on March 27. Laboratories and workshops will be open to public inspection about 9.15 p.m. Tickets of admission may be obtained on application at the institute.

BY the will of the late Alderman H. Harrison, Blackburn, legacies amounting to 82,600*l.* are bequeathed to public objects, among which are the following:—1000*l.* each to the Imperial Cancer Research Fund, the Cancer Investigation Department of the Middlesex Hospital, and the Cancer Hospital for cancer investigation; 5000*l.* to Manchester University for general purposes, and 1000*l.* for the Chinese chair; 2000*l.* to Blackburn Grammar School for playing-fields, and 1000*l.* for university scholarships.

IN the House of Commons on February 25 Sir P. Magnus asked the Prime Minister whether the Government intended to introduce this session a Bill for the reorganisation of the University of London, and, if so, whether that Bill would be presented as a separate measure or as part of the measure for the development of a national system of education. In reply, Mr. Asquith said:—"Pending the report of the Departmental Committee on the University of London, I am not in a position to announce the intentions of the Government. It will probably be convenient and desirable to deal with this question in a separate measure."

A SERIES of conferences on the educational value of the kinematograph was held in connection with the recent International Exhibition in Glasgow. The inaugural address at the opening of the exhibition by Sir John Ure Primrose was largely devoted to the educational possibilities of the kinematograph. The educational conferences were begun on February 19, under the presidency of the Lord Provost of Glasgow by an address from Prof. J. W. Gregory on the kinematograph as an educational medium, in which he described its value in many fields of educational work, and notably in geography and technology. In later sessions of the conference Mr. J. Cuthbertson, of the Glasgow High School, opened a discussion on the kinematograph as an aid to literary studies, Mr. G. Eyre-Todd on its use in the teaching of history and geography, Mr. D. B. Duncanson, of the Glasgow Provincial Training College, on its scientific and industrial applications, and Dr. John Smith, chairman of the Govan School Board, on its value in nature-study. At the close of the conference a resolution directing the attention of the Scottish Board of Education to the educational value of the kinematograph was adopted unanimously.

In a pamphlet entitled "Some Roads Towards Peace," a report to the trustees of the Carnegie Endowment for International Peace, Mr. Charles W. Eliot gives an open-minded and businesslike account of his sojourn in China and Japan in 1912. The keynote of the report is education, modern scientific education, such as Japan has developed and China would fain see established. According to his report, the well-known and often repeated taunt that the Japanese tradesmen are untrustworthy in commercial dealings is now quite out of date; and this is plainly due to the enlightened educational policy of the leaders of Japan during the last generation. His picture of the evils attending the introduction and development of factories is not pleasing; but it is certainly no worse than in Western lands. The influence for good of the missionary, and especially the medical missionary, is strongly emphasised. Among some of the immediate outcomes of Mr. Eliot's official visit to the far Orient may be mentioned three memorials which appear among the six appendices to the pamphlet. One is an appeal from prominent Chinamen to the trustees of the Carnegie Endowment for a free public library in Peking; the second is an appeal to the same trustees for an international hospital for Tokyo, signed by leading Japanese and European and American residents; and the third is a memorial on the subject of the education of the children of foreign residents in the Far East—the great need of a well-endowed school to take the place of the present inadequate Tokyo Grammar School. There is little doubt that by supporting such educational and medical needs the trustees of the Carnegie Endowment would do effective service in the cause of international peace.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 26.—Sir William Crookes, O.M., president, in the chair.—Lord **Rayleigh**: The diffraction of light by spheres of small relative index.—Prof. H. E. **Armstrong** and Prof. F. P. **Worley**: Studies of the processes operative in solutions. XXXI.—Sulphonic acids and sulphuric acid as hydrolytic agents: a discussion of the constitution of sulphuric and other polybasic acids and of the nature of acids. XXXII.—The influence of sulphonates on the hydrolytic activity of sulphonic acids: a contribution to the discussion on the influence of neutral salts.—Prof. H. E. **Armstrong**, R. T. **Colgate**, and E. H. **Rodd**: Morphological studies of benzene derivatives. V.—The correlation of crystalline form with molecular structure: a verification of the Barlow-Pope conception of "valency-volume."—Prof. E. **Wilson**: The magnetic properties of iron when shielded from the earth's magnetism. When iron is subjected to a considerable magnetising force, a species of polarisation is produced which has the effect of reducing the permeability and increasing the dissipation of energy due to magnetic hysteresis for given values of the magnetic induction. The residual effects can be removed by careful demagnetisation or annealing. It was thought by analogy that the earth's magnetic force would also have a polarising influence upon exposed iron, and this is the subject of the present paper. An effort has been made to remove the residual effects of the earth's magnetism by placing the specimen, which is of ring form, in a magnetic shield, and carefully demagnetising it. The magnetic properties of the material were then examined in the usual manner with a ballistic galvanometer, and a comparison made with those obtained from the exposed or unshielded specimen. It has been found that the permeability of *freshly* demagnetised and shielded iron, corresponding to a given value of the magnetic induction, is considerably larger than in the case of the unshielded specimen.—Dr. J. N. **Pring**: The occurrence of ozone in the upper atmosphere. In the Alps, at an altitude of 2100 metres, the mean concentration of ozone is about 2·5 parts by volume in one million of air, and at an altitude of 3600 metres, about five parts in one million of air. In this country the *mean* quantity found between ground-level and an altitude of 20 kilometres was about two parts by volume in one million. No trace of either hydrogen peroxide or nitrogen peroxide could be detected in these cases. Measurements made in the laboratory on the action of ultra-violet light on air showed that a definite equilibrium amount of ozone is obtained, and that this value increases with fall in temperature, but decreases rapidly with fall in pressure. The formation of hydrogen peroxide or nitrogen peroxide by ultra-violet light radiation could not be detected.—W. A. D. **Rudge**: A meteoric iron from Winburg, Orange Free State. In this paper some account is given of the structure, and mechanical and magnetic properties, of the Winburg meteorite, which is stated to have fallen in 1881. It appears to be composed of large crystals of ferrite with veins and crystals of an iron nickel alloy. The total amount of nickel is not more than 3 per cent.—W. A. D. **Rudge**: The electrification produced during the raising of a cloud of dust. During the raising of a cloud of dust a considerable amount of electrification occurs. Insulated conductors held in a stream of dust become charged to a potential of some hundreds of volts. The dust particles seem to be charged by friction amongst themselves, some with positive, others with negative, electricity.—Prof. W. M. **Thornton**: The electrical ignition of gaseous mixtures. This is an experimental examination of the mechanism of ignition of gaseous mixtures by electric sparks. It is found that there are two distinct types of curve connecting percentage of gas in air and the least current which, when broken, causes ignition by the break-spark. In one, characteristic of continuous currents, the current required is proportional to the percentage of gas present; in the other, of the alternating-current type, it is a quadratic function of the percentage, having a minimum, at the mixture giving combustion, midway between CO and CO_2. Ignition by continuous-current break-sparks is largely ionic or electronic, but by alternating currents is more nearly a simple thermal process. The gases examined were hydrogen, carbon disulphide, benzene, alcohol, and the paraffin series up to pentane.

Linnean Society, February 5.—Prof. E. B. Poulton, president, in the chair.—J. **Davidson**: The mouth-parts and mechanism of suction in *Schizoneura lanigera*, Hausm. The object of this paper is to give a detailed description of the anatomy and relations of the mouth-parts of aphids, with special reference to the working of these structures during the processes of feeding.—Dr. L. **Cockayne**: The vegetation of White Island, New Zealand.—W. E. **Collinge**: The range of variation of the oral appendages in some terrestrial Isopods. After carefully examining and considering the variations described, the conclusion is reached that the oral appendages are subject to a considerable amount of variation, and for purposes of specific distinction are not of the value generally supposed, and certainly not so constant as to the form of the head, the mesosomatic segments, the antennæ, the telson, uropoda, and thoracic appendages; they may, however, serve to characterise the larger divisions of the group.

February 19.—Prof E. B. Poulton, president, in the chair.—Dr. J. P. **Lotsy**: The origin of species by crossing. In all questions of evolution facts are gathered from individuals, because species as well as varieties are abstractions, not realities. Nobody is able to show a species or a variety; all he can do is to show one or more individuals which he believes to belong to the species or variety under discussion. Of *individuals* we know two kinds: homozygotes and heterozygotes. The first are stable, the latter segregate, earlier or later, into new homozygotes. The offspring of a homozygote is identical with its parent with the exception of mere temporary, non-transmittable modifications. If this be true, selection in the progeny of a definite homozygote can have no effect. That it *has* no effect has been proved by Johannsen. A homozygote consequently is absolutely stable and produces offspring which is genetically identical to it. Different kinds of homozygotes may be called genotypes, because they differ in genetical constitution, and we can then say that the world is populated—with the exception of heterozygotes—by a large number of sharply defined absolutely stable genotypes. Under such conditions evolution may well seem impossible; fortunately, the behaviour of the heterozygotes shows us that it is very well possible. A careful study of the descendants of a heterozygote shows us that it segregates in the next or later generations in a number of individuals, part of which are heterozygous, but part of which are homozygous, and that these homozygotes belong to different genotypes. It was submitted that the real units of the living kingdom are genotypes; that such genotypes can, under proper precautions, be kept pure for an indefinite time; and that there is no certain evidence that they can be changed in any other way than by crossing. What then is *the reason of the apparent variability of a species in the Linnean sense?* In the first place the fact that a Linnean species is a *collection* of independent stable Jordanian species. The author expressed his firm conviction, as explained before, that no transmittable variation exists, and that all apparent variability is due to an original cross. Finally, the author proceeded to the origin of species before sexual reproduction took place.

Physical Society, February 13.—Prof. C. H. Lees, vice-president, in the chair.—R. Ll. **Jones**: The moving coil ballistic galvanometer.—A. **Campbell**: Vibration galvanometers of low effective resistance. The mathematical theory of the motion of the moving coil of a vibration galvanometer is first given (partly following Wenner), and simple relations are shown to hold between the two resonance frequencies, the free frequency, and the amplitude time constant. It is also shown how all the constants of the equation of motion can be deduced from observations of the direct- and alternating-current sensitivities, the alternating voltage sensitivity and the "dead" resistance. A complete table of the observed and deduced constants is given for a series of very small coils, the number of turns in these varying from one to forty.—Dr. H. J. S. **Sand**: Vacuum-tight lead seals for leading-in wires in vitreous silica and other glasses. The author has found that lead which has been allowed to solidify in contact with glass will, if free from oxide, form a vacuum-tight joint with the latter. Owing to the very great firmness with which the metal adheres, and owing to its great plasticity, these joints can stand temperature changes without damage.

Zoological Society, February 17.—Prof. E. A. Minchin, vice-president, in the chair.—Dr. R. T. **Leiper** and Surgeon E. L. **Atkinson**: The Helminthes collected by the British Antarctic Expedition (*Terra Nova*), 1910–13. The collection contained nine forms previously recorded from the Antarctic zone, three previously recorded only from the Arctic regions, and one other previously recorded elsewhere and now found in the Antarctic zone, and fifteen new species and four new genera. Of the forms obtained in tropical and temperate zones during the voyage, three had been recorded previously and five were new species.—C. G. **Seligmann** and S. G. **Shattock**: The seasonal assumption of the "eclipse" plumage in the mallard (*Anas boscas*) and the function of the testicle. Though the seasonal change of plumage did not correspond with the spermatogenic function of the testicle, its connection with the production of an internal secretion could only be settled by castration followed absolutely without regeneration; this could be ensured only by reopening the abdomen under an anæsthetic and removing any reproduced tissue found.—Dr. F. **Wood-Jones**: Some phases in the reproductive history of the female mole (*Talpa europea*).—H. C. **Chadwick**: Notes on an imperfectly developed specimen of the sea-urchin (*Echinus esculentus*).—C. F. U. **Meek**: The possible connection between spindle-length and cell-volume. In *Forficula auricularia*, *Helix pomatia*, and man the ratio between the lengths of the mitotic spindle in the two spermatocyte metaphases seemed to be identical or almost identical with the ratio between the radii of two spheres, of which the volume of one is equal to twice that of the other; and, since the volume of the primary spermatocyte cell in the metaphase is presumably equal to twice that of the secondary spermatocyte, connection was suggested between the spindle-length and cell-volume at this stage.—F. F. **Laidlaw**: A further contribution to the study of the dragon-fly fauna of Borneo. The paper dealt with the Gomphinæ and Chlorogomphinæ, of which a number of new species and subspecies was described.

Royal Anthropological Institute, February 17.—Prof. A. Keith, president, in the chair.—S. Hazzledine **Warren**: The experimental investigation of flint fracture and problems of early man. The paper describes experiments conducted for the purpose of investigating the chipping properties of flint, when operated upon by forces of measured strength. In the case of mechanical concussions the chief method employed was by the impact of bodies of known weight falling under the acceleration of gravity from a measured height. Some striking illustrations of the lines of least resistance in flint were thus obtained. As an instance of this, free chipping was obtained by blows of an energy of 0·8 foot-pounds, delivered at a velocity of 15 ft. a second, in one direction upon a flint. But, at the same time, blows of an energy of 22 foot-pounds, delivered at a velocity of 18·8 ft. a second, upon the opposite side of the same flint, had no effect except to continue chipping in the original direction by the back-pressure of the support on which the flint was placed for experiment. The lines of least resistance depend very largely upon the original shape of the piece of flint used for the experiment. It is argued that these properties must also have their influence in the chipping of flints by natural agencies, and may well induce a deceptive appearance of purposeful blows having been delivered in one direction only. A series of experiments showing the effects of differential movement under loads of from 14 to 250 lb. are also described. The similarity of these mechanical effects to the "eoliths" of Kentish type is pointed out.

Royal Meteorological Society, February 18.—Mr. C. J. P. Cave, president, in the chair.—Dr. W. N. **Shaw**: The interpretation of the results of soundings with pilot balloons. The author dealt with the calculation of the distribution of pressure and temperature from the observed horizontal wind velocity at different heights and gave examples of the application of this method to certain types of atmospheric structure represented in Mr. Cave's book. When we find irregular fluctuations in the wind velocity we must look for corresponding irregularities in temperature and pressure differences at the several levels. These irregularities are obvious characteristics of the observations of wind velocity, pressure difference, and temperature difference.—G. M. **Dobson**: Pilot balloon ascents at the Central Flying School, Upavon, during the year 1913. These balloon ascents are made with the object of obtaining information which will be of use for pilots in flying. The results given in this paper are based upon ninety-seven ascents. It is found that the direction of the wind veers from, and its velocity increases with, increasing height above the ground, until the gradient direction and velocity are reached. The gradient velocity is usually reached at a height of 300 metres, though the gradient direction is not found until a height of about 800 metres. At higher altitudes the velocity tends to increase, and the direction continues to veer, slightly beyond the gradient velocity and direction.

CAMBRIDGE.

Philosophical Society, February 9.—Prof. Seward, vice-president, in the chair.—A. S. **Marsh**: The history of the occurrence of Azolla in the British Isles and in Europe generally. *Azolla filiculoides* has recently been found in Jesus Ditch, Cambridge. This species, which is now common in the Norfolk Broads, has been several times wrongly described as *A. caroliniana*, an earlier introduction, from which it is distinguished by its larger size, different habit, and the microscopic characters of the reproductive organs.—R. C. **McLean**: Amitosis in the parenchyma of water plants. The author described the occurrence of the direct or amitotic form of nuclear division in the cortical parenchyma of certain water plants. The nuclei show peculiar sigmoid forms and remain associated in pairs in the cells. The phenomenon is most frequent in actively growing regions, so cannot be due to senility. —Agnes **Arber**: Root development in *Stratiotes aloides*, L., with special reference to the occurrence of amitosis in an embryonic tissue. An account is given of certain features of the general development and the cytology of the adventitious roots of *Stratiotes aloides*. The various points dealt with include the nature of the root-cap, the origin of the lacunæ of the middle cortex, &c. The greater part of the paper, however, is concerned with an account of amitosis in the root-cap, cortex, and stele of the immature root.

DUBLIN.

Royal Irish Academy, February 23.—Rev. Dr. Mahaffy, president, in the chair.—M. W. J. **Fry**: Extension of number by the introduction of the symbols $+$, $-$, and i. Recognising that quantities of the same kind are divisible into two groups, usually styled positive and negative quantities, to distinguish the author called a unit to measure quantities of one group α, and a unit to measure quantities of the other group β. Two quantities, such as 12α and 9β combine to give 3α, and so on. Denoting ordinary numbers by a, b, c, he defined $+a$ written in front of any quantity $b\alpha$ or $b\beta$, to mean that the quantity is to be multiplied by a and the unit not altered, and by $-b$ that the quantity is to be multiplied by b and the unit altered to the other unit, so that $+ba\alpha = ba\alpha$, $-ba\alpha = ba\beta$, $-ba\beta = ba\alpha$, $+ba\beta = ba\beta$. The rule of signs in this generalised multiplication is then obvious, and as $b\beta = -b\alpha$, the symbol β may be dispensed with, and any quantity may be expressed in the form $x\alpha$, where x is an ordinary number with the sign $+$ or $-$ prefixed to it, and forms a generalised number, or real number. From these definitions he developed the algebra of real numbers, which is incomplete in the well-known ways. To generalise number further so that all operations may be performed, he began with a group of four fundamental units α, α', β, β', arranged in cyclical order instead of two. Of these four an opposite pair, α, β, are a pair of units considered before, and the other pair are any other similarly related pair whatsoever. Defining ia written in front of any quantity $b\alpha$ or $b\alpha'$, or $b\beta$ or $b\beta'$ to mean that the quantity is to be multiplied by a and the unit altered to the next in cyclical order, it follows that $2^2 = -1$, $2^3 = -2$, $2^1 = 1$, and that any quantity $a\alpha + b\beta + c\alpha' + d\beta'$ can be written in the form $(x + iy)\alpha$. Thus the further generalised quantity is $(x + iy)\alpha$, and further generalised number $x + iy$. From these definitions he developed the algebra of complex numbers.

PARIS.

Academy of Sciences, February 23.—M. P. Appell in the chair.—E. **Guyou**: The homogeneity of equations and the simplification of problems when certain quantities become small.—Paul **Sabatier** and M. **Murat**: Contributions to the study of benzhydrol: the preparation of benzhydrol and tetraphenylethane. In the preparation of benzhydrol by the Grignard synthesis from benzaldehyde or ethyl formate and phenylmagnesium bromide the yield of benzhydrol is poor, symmetrical tetraphenylethane appearing as the main product of the reaction. This has now been traced to the conditions of hydrolysis of the organo-magnesium compound. During the fractional distillation of the ether solution of the reaction products decomposition of the benzhydrol takes place, and this has been shown to be due to the catalytic action of small proportions of impurities in the liquid, since a similar change does not occur when pure solutions of benzhydrol are distilled. The conditions for obtaining a good yield of the benzhydrol are given.—A. **Véronnet**: The cooling of the earth: its evolution and duration. The formula established is similar to that of Fourier, but the proof is simpler. The time is 2·46 times that given by the Fourier hypothesis, but it remains of the order of millions of years.—M. **Fessenkoff**: The capture of comets by Jupiter.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1913. Tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—J. **Darmois**: The method of Laplace.—G. **Pick**: The evaluation of distances in functional space. Ph. **Franck**: The approximate evaluation of the smallest characteristic value of some integral equations.—G. **Kowalewski**: Intrinsic geometry and the first fundamental proposition of Sophus Lie.—Alfred **Rosenblatt**: Certain integrals of a system of two ordinary differential equations of the first order satisfying initial singular conditions.—Louis **Benoist** and Hippolyte **Copaux**: Some new proofs of the laws of transparency of matter for the X-rays in the special case of complex mineral salts. The substances examined included potassium ferrocyanide, cobaltic chloropentammine and potassium silicomolybdate. There was a good agreement between the found values and those calculated on the assumption that the transparency to the X-rays is an atomic property.—B. **Szilard**: The measurements of electrical potentials at a distance without wires. A disc coated with 0·1 milligram of radium bromide is insulated and connected with a static electrometer. When the disc is placed facing a charged conductor it acquires a potential varying with the distance, and this potential as read off on the electrometer can be used to measure the potential of the charged conductor. For the instrument described, the disc being at a distance of one metre from the charged plate, the voltage shown by the electrometer was about one-twentieth of that of the plate. Various practical applications of the method are indicated.—S. **Ratner**: A new form of electric breeze.—Jean **Bielecki** and Victor **Henri**: The influence of the ethylene linkage and the carbonyl and carboxyl groups on the absorption of ultra-violet light. Ten substances were studied and the results summarised on three diagrams.—Eugène **Wourtzel**: The decomposition of gaseous ammonia under the influence of the radium emanation and the influence of temperature on the chemical effects produced by the radiations of radio-active bodies. Ammonia is decomposed solely into hydrogen and nitrogen by the radium emanation. The quantity of gas formed per unit of emanation destroyed increases with the pressure. Rise of temperature favours the destruction of the ammonia. The number of cubic centimetres of ammonia destroyed per unit of radiation is nearly doubled at 108° C., and more than tripled at 220° C.—F. **Leprince-Ringuet**: Experiments on the absorption of gases by coal. Three kinds of coal were treated with a gaseous mixture approximating to the fire-damp of a coal mine, and the absorption studied at varying pressures. The results afford no explanation of the sudden disengagement of marsh gas in fiery mines.—F. **Ducelliez** and A. **Raynaud**: The bromination of manganese in ethereal medium. Finely divided manganese and bromine, if dry, do not react at the ordinary temperature: in presence of ether the compound,

$$MnBr_2.(C_2H_5)_2O,$$

is readily formed, and this when heated loses ether and yields the anhydrous manganese bromide. When the bromine is in large excess another bromide is formed having the composition $MnBr_3(C_4H_{10}O)_3$.—Maurice **Billy**: Improvement in the preparation of some pure metals. A description of the preparation of pure titanium free from iron, by the interaction of titanium tetrachloride and sodium hydride. The use of sodium hydride as a reducing agent possesses the advantage that the reduction takes place at about 400° C., and consequently the whole apparatus can be constructed of ordinary soda glass.—J. B. **Senderens** and Jean **Aboulenc**: The esterification of glycerol by acetic acid in the presence of catalysers. As catalytic agents potassium bisulphate, anhydrous aluminium sulphate, and 1 per cent. sulphuric acid were used, the latter being found to give the best yields.—E. **Gourdon**: The mineralogical constitution of the southern Shetlands (Deception Island).—Miramond de **Laroquette**: Variations of food ration and the weight of the body under the action of solar radiation at various seasons of the year.—G. **Marinesco** and J. **Minea**: Culture of the spinal ganglia in heterogeneous media. Spinal ganglia from the dog and cat were cultivated in the plasma of the rabbit, and the mode of growth studied.—A. **Moutier**: Arterial hypertension.—Jean **Gautrelet** and Henri **Neuville**: The blood of the mammoth.

BOOKS RECEIVED.

A Laboratory Manual of Organic Chemistry for Beginners. By Prof. A. F. Holleman. Edited by Dr. A. Jamieson Walker. Second edition. Pp. xvii+83. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Deutsches Meteorologisches Jahrbuch für 1911. Elsass-Lothringen. Pp. viii+59. (Strassburg i.E.: G. Fischbach.)

De la Pirotechnia. By V. Biringuccio. Pp. lxxxv+198. (Bari: Società Tipografica Editrice Barese.) 3 lire.

Kaiserliche Marine. Deutsche Seewarte. III. Nachtrag zum Katalog der Bibliothek der Deutschen Seewarte zu Hamburg. 1 April, 1899, bis 31 Dezember, 1912. Pp. viii+341. (Hamburg.)

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1907–08 to 1911–12. Vol. i., British India. Pp. iii+420. (Calcutta: Superintendent, Government Printing, India.) 3*s*. 9*d*.

Canada. Department of Mines. Geological Survey. Memoir No. 30. The Basins of Nelson and Churchill Rivers. By W. McInnes. Pp. vii+146+xix plates. (Ottawa: Government Printing Office).

The Currents in Belle Isle Strait. From Investigations of the Tidal and Current Survey in the Seasons of 1894 and 1906. By Dr. W. Bell Dawson. (Ottawa: Government Printing Office.)

The Co-operation of Science and Industry. By S. Roy Illingworth. Pp. 91. (London: C. Griffin and Co., Ltd.) 1*s*. 6*d*. net.

A Text-Book of Physics: Electricity and Magnetism. By Dr. J. H. Poynting and Sir J. J. Thomson. Parts i. and ii., Static Electricity and Magnetism. Pp. xiv+345. (London: C. Griffin and Co., Ltd.) 10*s*. 6*d*.

Chemistry and its Borderland. By Dr. A. W. Stewart. Pp. xii+314+ii plates. (London: Longmans, Green and Co.) 5*s*. net.

Union of South Africa. Department of Agriculture. Report with Appendices for the Period January 1, 1912, to March 31, 1913. Pp. 373+plates. (Cape Town: Cape Times, Ltd.) 9*s*. 6*d*.

Meteorological Office. Geophysical Memoirs Nos. 5, 6, and 7. (London: H.M. Stationery Office; Meteorological Office, South Kensington.)

The Change in the Climate and its Cause. By Major R. A. Marriott. Pp. 94. (London: E. Marlborough and Co.) 1*s*. 6*d*.

County Borough of Halifax. Bankfield Museum Notes. Second series. No. 3, The Letter Books of Joseph Holroyd (cloth-factor) and Sam Hill (clothier). Transcribed and edited by H. Heaton. Pp. 41. (Halifax: F. King and Sons, Ltd.) 2*s*.

The Mechanical Engineer's Reference Book. A Handbook of Tables, Formulas, and Methods for Engineers, Students and Draftsmen. By H. H. Suplee. Fourth edition, revised and enlarged. (London and Philadelphia: J. B. Lippincott Co.) 18*s*. net.

Textiles: a Handbook for the Student and the Consumer. By Mary S. Woolman and Ellen B. McGowan. Pp. xi+428. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Engineering Workshop Exercises. For Technical Students and Apprentice Engineers. By E. Pull. Pp. viii+80. (London and New York: Whittaker and Co.) 2*s*. net.

Wireless Telegraphy: a Handbook for the Use of Operators and Students. By W. H. Marchant. Pp. xi+241. (London and New York: Whittaker and Co.) 5*s*. net.

Test Papers in Elementary Algebra. By C. V. Durell. Pp. viii+233. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Le Leghe Metalliche ed i Principii Scientifici della Metallografia Moderna. By Prof. D. Mazzotto. (Modena, Italy: G. T. Vincenzi e Nipoti.) 6 lire.

My Garden in Spring. By E. A. Bowles. Pp. x+308+plates. (London and Edinburgh: T. C. and E. C. Jack.) 5*s*. net.

Sexual Ethics: a Study of Borderland Questions. By Prof. R. Michels. Pp. xv+296. (London and Felling-on-Tyne: Walter Scott Publishing Co.) 6*s*. net.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the Year 1911. Part ii., Climatological and Rainfall Observations. Pp. xvi+198. (Cairo: Government Press.) P.T.15.

The Carnegie Trust for the Universities of Scotland. Twelfth Annual Report (for the Year 1912–13) submitted by the Executive Committee to the Trustees on February 25, 1914. Pp. iv+188. (Edinburgh: T. and A. Constable.)

Wissenschaft und Methode. By H. Poincaré. Autorisierte deutsche Ausgabe mit Erläuternden Anmerkungen von F. and L. Lindemann. Pp. v+283. (Leipzig und Berlin: B. G. Teubner.) 5 marks.

Darstellende Geometrie des Geländes. By Prof. R. Rothe. Pp. 67. (Leipzig und Berlin: B. G. Teubner.) 80 pfennigs.

Beobachtungen über Strandverschiebungen an der Küste des Samlands. By Dr. R. Brückmann. iii., Palmnicken. Pp. 117–144+plates. (Leipzig und Berlin: B. G. Teubner.) 3 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lieferung 72 and 73. (Jena: G. Fischer.) 2.50 marks each Lief.

Text-Book on Railroad Surveying. By G. W. Pickels and C. C. Wiley. Pp. ix+263. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s.* 6*d.* net.

Canada. Department of Mines. Geological Survey. Memoir No. 23. Geology of the Coast and Islands between the Strait of Georgia and Queen Charlotte Sound, B.C. By J. Austen Bancroft. Pp. viii+146+xvii plates. (Ottawa: Government Printing Bureau.)

India-Rubber Laboratory Practice. By Dr. W. A. Caspari. Pp. viii+196. (London: Macmillan and Co., Ltd.) 5*s.* net.

Some Fundamental Problems in Chemistry Old and New. By Prof. E. A. Letts. Pp. xiii+235+plates. (London: Constable and Co., Ltd.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 5

ROYAL SOCIETY, at 4.30.—The Action of Light on Chlorophyll: H. Wager.—Formaldehyde as an Oxidation Product of Chlorophyll Extracts: C. H. Warner.—The Controlling Influence of Carbon Dioxide in the Maturation, Dormancy, and Germination of Seeds: F. Kidd.—The Functional Correlation between the Ovaries, Uterus and Mammary Glands in the Rabbit, with Observations on the Œstrous Cycle: J. Hammond and F. H. A. Marshall.—The Chromaffine System of Annelids and the Relation of this System to the Contractile Vascular System in the Leech, *Hirudo medicinalis*: Dr. J. F. Gaskell.

ROYAL INSTITUTION, at 3.—Heat and Cold: Prof. C. F. Jenkin.

CHILD STUDY SOCIETY, at 7.30.—The Sense of Humour in Children: Miss C. C. Graveson.

LINNEAN SOCIETY, at 8.—Results of Crossing *Euschistus variolarius* and *E. servus* with Reference to the Inheritance of an Exclusively Male Character: The Misses K. Foot and E. C. Strobell.—Short Cuts by Birds to Nectaries: C. F. M. Swynnerton.—Buprestidæ: Ch. Kerremans.—Platypodidæ and Ipidæ from the Seychelles: Lieut.-Col. Winn Sampson.—Scatopsidæ and Simuliidæ: Dr. G. Enderlein.—Heteroneuridæ—Milichiidæ: C. G. Lamb.

FRIDAY, MARCH 6.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Maihak Indicator and Bottchers Power Counter: F. E. Rainey.

GEOLOGISTS' ASSOCIATION, at 8.—A Study of Ballstone and the Associated Beds in the Wenlock Limestone of Shropshire: Miss M. C. Crossfield and Miss M. S. Johnston.

SATURDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

MONDAY, MARCH 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Nigeria-Kamerun Boundary Commission of 1912–13: Capt. W. V. Nugent.

TUESDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Modern Ships. II. Ocean Travel: Sir John H. Biles.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Magical Siege of Troy: A. Upward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Rail-steels for Electric Railways: W. Willox.—Rail-corrugation and its Causes: S. P. W. D'Alte Sellon.

WEDNESDAY, MARCH 11.

ROYAL SOCIETY OF ARTS, at 8.—Bacterial Treatment of Peat, and its Application as a Fertiliser: Prof. W. B. Bottomley.

GEOLOGICAL SOCIETY, at 8.—An Apparently Palæolithic Drawing on a Bone from Sherborne (Dorset): Dr. A. Smith Woodward.

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Note on a Functional Equation Employed by Sir George Stokes: Sir James Stirling.—The Mercury Green Line $\lambda = 5461$ as Resolved by Glass and Quartz Lummer Plates and on its Zeeman Components: Prof. J. C. McLellan and A. R. McLeod.—The Electrical Condition of a Gold Surface During the Absorption of Gases and their Catalytic Combustion: H. Hartley.—The Diffusion of Electrons through a Slit: J. H. Mackie.—The Rate of Solution of Hydrogen by Palladium: Dr. A. Holt.

ROYAL INSTITUTION, at 3.—Heat and Cold: Prof. C. F. Jenkin.

CONCRETE INSTITUTE, at 7.30.—Forms for Concrete Work: A. Graham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Design of Rolling Stock for Electric Railways: H. E. O'Brien.

FRIDAY, MARCH 13.

ROYAL INSTITUTION, at 9.—An Indian State: Sir Walter R. Lawrence, Bart.

MALACOLOGICAL SOCIETY, at 8.—Diagnosis of Four New Land Shells from German New Guinea: C. R. Boettger.—Characters of Three New Species of Ennea from Southern Nigeria: H. B. Preston.—A Synopsis of the Family of Veneridæ. II.: A. J. Jukes-Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Lightning Conductors and their Tests: F. H. Taylor.

ALCHEMICAL SOCIETY, at 8.15.—Roger Bacon: R. Rowbottom.

PHYSICAL SOCIETY, at 8.—Time Measurements of Magnetic Disturbances and their Interpretation: Dr. C. Chree.—The Ratio of the Specific Heats of Air, Hydrogen, Carbon Dioxide and Nitrous Oxide: H. N. Mercer.—The Asymmetric Distribution of the Secondary Electronic Radiation produced by X-Radiation: A. J. Philpot.

SATURDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

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THURSDAY, MARCH 12, 1914.

CHEMISTRY FOR ADVANCED STUDENTS.

(1) *A Treatise on Chemistry.* By H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol., ii., The Metals. New edition completely revised by the Rt. Hon. Sir Henry Roscoe and others. Pp. xvi+1470. (London: Macmillan and Co., Ltd., 1913.) Price 30*s.* net.

(2) *A Dictionary of Applied Chemistry.* By Sir Edward Thorpe, C.B., F.R.S. Assisted by Eminent Contributors. Revised and enlarged edition. In five volumes. Vol. v., Pp. viii+830. (London: Longmans, Green and Co., 1913.) Price 45*s.* net.

JUST as the leaves of our deciduous plants fade away in autumn, and in winter perish, so do our science books have their autumn and their winter. They cannot live long under a *régime* which changes with the fleeting years. The publisher's spring-time brings forth an array of fresh books, but none are more welcome than some of the older and familiar forms revitalised and newly adapted to the change of environment. The reviewer has therefore a pleasing task in introducing the new editions of the above-named books to readers of NATURE, and this the more because each book is a familiar friend to chemists the world over.

(1) The new edition of "Roscoe and Schorlemmer"—as it is colloquially called—merits a hearty welcome. This book stands on the most convenient shelf in the libraries of thousands of chemists, and its well-thumbed pages bear eloquent testimony to its utility and value. This has continued, edition after edition, since 1878, when vol. i. was published. The first edition was thus born before many of us, in this generation, took up the test-tube and the wash-bottle; and we have grown up using "Roscoe and Schorlemmer" as a kind of alkoran. The book, in consequence, must have exercised a deep influence on the present generation, and it is a book of which British chemists have been proud.

It is interesting to see how the concepts of physical chemistry gradually permeate, modify, and illume even so conservative a subject as the "Systematic Description of the Metals and their Derivatives." True enough, there are no very marked changes in the descriptive matter ranging from pages 224 to 1406, yet the first 223 pages are largely occupied by physical chemistry, and the last 42 pages have a clear succinct account of the present state of our knowledge of that fascinating subject, "The Radioactive Elements." In the chapter on specific heats, a page or two might perhaps have been spared for Einstein's work on the atomic heats of solids to show how theory has at last given a reasoned explanation of the "constancy" of the number 6. The chapters on crystallography and on spectrum analysis are specially good. The new edition has all the strong points of former editions, and it can therefore be confidently recommended to advanced students as the best text-book extant on descriptive inorganic chemistry.

(2) The fifth volume of "Thorpe's Applied" completes the work. The concluding volume maintains the high standard of those which precede, and the observations on the fourth volume in NATURE, August 14, 1913, are of equal weight here. This volume covers subjects ranging from "Sodium to Z." The longer articles deal with sodium, soils, solutions and solubility, specific gravity, spectrum analysis, starch, sugar, sulphide dyes, sulphur and sulphuric acid, synthetic drugs or medical products, tannins, tartaric acid, tea, terpenes, thermometers, thermostats, thorium, tin, titanium, tobacco, toluene and toluidines, toxins and antitoxins, triphenylmethane colouring matters, tungsten, ultramarine, uranium, urea, uric acid, urine, vanadium, varnish, vat dyes, vegetable alkaloids, water, waxes, whisky, wine, destructive distillation of wood, wool, zinc, zirconium, etc. This list is quite inadequate, and gives but a feeble idea of the immense range of the subjects discussed in this volume. I am informed that the whole set of volumes contains some six thousand articles—short or long. The work is therefore *ganz deutsch* in its thoroughness.

As a rough imperfect test, in order to find how the fifth volume happens to fit the subjects in which I personally am interested, I wrote a list containing twenty items, and then consulted the "dictionary." I did not succeed in finding any mention of a thermostat for high temperatures (say 500°–1100°) for electrically heated muffles; or of μ- and λ-sulphur and their effect on the melting-point of the so-called "pure" sulphur. In the remaining eighteen cases the dictionary emerged triumphant. This result is very good, and illustrates the high probability that the work will not be found wanting when occasion demands. The dictionary, as a whole, reflects great credit on the wisdom and acumen of the editor, on the skilful and accurate condensations by the contributors, and on the enterprise and good taste of the publishers.

J. W. MELLOR.

DYNAMICS: OLD AND NEW.

(1) *Leçons sur la Dynamique des Systèmes matériels.* By Prof. E. Delassus. Pp. xii+421. (Paris: A. Hermann et Fils, 1913.) Price 14 francs.

(2) *The Theory of Relativity.* By Prof. R. D. Carmichael. Pp. 74. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 4*s.* 6*d.* net.

(1) THIS volume is the result of an experiment made by the author to improve on the usual methods of introducing students to the study of dynamics. The first respect in which this has been essayed is in presenting the subject from the beginning in a general form, instead of beginning with those problems which are geometrically most simple. Thus the volume has rather the appearance of a treatise on what is usually known as analytical dynamics. But the object which the author has in view is not so much the development of the advanced analytical theory, which becomes largely a study of differential equations, as a unification of method which shall obviate the feeding of the student on a multiplicity of isolated problems in which the dynamical properties are essentially of the same type.

Special attention is paid to the class of systems the equations of motion of which can be integrated by quadratures. An elaborate study is made of two special questions in respect of which the author considers wrong notions to be prevalent. The first of these is the assumption usually made in respect of a unilateral constraint, such as that which occurs when a body rolls or slides on another body, that the constraint will cease to be conformed to at the moment when the force required to maintain it vanishes and changes sign; examples are given in which the assumption that this is true where there is more than one point of contact between two bodies leads to wrong conclusions.

The other point which is called in question is the assumption, which the author considers to be often tacitly made, that if the constraint imposed on a system is realised by means of auxiliary bodies of negligible mass, these auxiliary bodies have no influence on the motion of the system. An example given is that of a heavy particle constrained to move in a horizontal plane by attachment to an axis bearing two weightless wheels which roll and slide respectively on a fixed horizontal plane. It is clear that if the wheels and axis have ever so little inertia and are set in motion with a rotation about the vertical, the particle cannot describe a straight line, but the example points to such an obvious objection to the assumption referred to that it is difficult to believe that as a general rule it has really been commonly asserted.

(2) After reading this careful course on classical dynamics, it is an abrupt transition to the first book published in English on the principle of relativity, and to read of a revision of the fundamental concepts, not only of space and time, but also of mass. Prof. Carmichael sets out to give a popular account of the way in which these magnitudes are regarded by the exponents of this most up-to-date of generalisations, without going into the details of its origin in electrical theory.

The project is well carried through, but it seems doubtful whether even yet the public mind is prepared to face the shock of the postulate (p. 20): "The velocity of light in free space, measured on an unaccelerated system of reference S, is independent of the velocity of S." But less objection seems to be taken to one of the consequences of the assumption of the complete relativity of all physical phenomena, namely, the dependence of the mass of a body upon its velocity, in spite of its reducing the status of Newtonian mechanics to that of an approximate theory.

The reason for this is probably that experiment seems to have demonstrated without doubt that the mass of the electron must be admitted to be variable, and we can find no reason for denying the possibility of the mass of any body varying within the limits of error admitted by astronomical theory.

The real obstacle to the acceptance of the theory of relativity is the carrying over of a conception of space and time, which is based on, or rather part of, Newton's dynamical theory into regions where that theory is certainly no longer tenable in its entirety. Prof. Carmichael's book deals entirely with these fundamental matters and will help to make more familiar a more logical and less metaphysical view of space and time in their physical bearing.

NEW ZEALAND: THEN AND NOW.

(1) *Camp Fire Yarns of the Lost Legion.* By Col. G. Hamilton-Browne. Pp. xiii+301. (London: T. Werner Laurie, n.d.) Price 12*s.* 6*d.* net.

(2) *Social Welfare in New Zealand.* By Hugh H. Lusk. Pp. viii+287. (London: William Heinemann, 1913.) Price 6*s.* net.

THESE two books present a most vivid picture of the progress which has occurred in New Zealand during the last fifty years. The first is essentially personal, the account of strange and curious adventures of individuals; the second is largely impersonal, the account of the development of a system of State Socialism. Both works tell the story of the reaction between outsiders from overseas and the environment which they found awaiting them in these distant islands.

(1) The gallant colonel, typically a frontiersman, presents a picture of the Maori wars, and demonstrates the dangers of the trackless bush. The Maori regarded war as essentially the work for men; their curious outlook caused them to regard the shot which landed in their "pah" during a bombardment and failed to explode as the enemy's method of supplying them with powder with which to continue fighting. Mr. Lusk, formerly a member of the New Zealand Parliament, states that Maoris nowadays receive old-age pensions on the same terms as the white men.

The camp-fire yarns are racy, redolent of the soldier's vocabulary, and make excellent reading; the parliamentarian account (2) of organised attention to the well-being of the community as a whole community, and not as a congeries of classes of society, is calm, dispassionate, careful, and on this account eminently readable.

Steadily, step by step, the State interfered with manifestations of private enterprise, prevented the permanent establishment of a landed gentry, or of a body of yeomen tenant farmers; established systems of communication by rail, by telegraph, and by telephone, which have contributed greatly to a feeling of national unity; freed the country from outside influences as regards fluctuations in coal prices; secured loans of capital for all the people at advantageous rates, so preventing the exploitation of the farmers because they were necessitous; and, by controlling the development of the country, secured a high average of prosperity to all members of the State, without causing the growth of either a wealthy or a poverty-stricken caste.

Mr. Lusk is of opinion that New Zealanders grew, without definite intention, or without definite leadership, to regard the welfare of all as paramount, and he is further of the opinion that New Zealand sets an object-lesson to the whole world in its regard for all members of the body politic; he pays more attention to the principle which underlies these progressive movements than to the fact that New Zealand is a special case. Regarded as a contribution to the knowledge of the world, New Zealand's progress is a striking illustration of the unique reaction to its own local environment, which occurs in a more or less isolated community. More than a thousand miles from its nearest neighbour, with a small population of a million souls, with a large area of cultivable land, in the happy position of having one market only, and that a certain one for its surplus of food-stuffs and raw material, almost outside the stress and strain of international competition, New Zealand has developed along lines which were only possible in such comparative isolation. But it is hazardous to generalise from so specific an example; while, on one hand, it is possible to note the fact of New Zealand's prosperity, it is incorrect, on the other, to infer from New Zealand's experience principles of State activity which shall be regarded as of general application.

It does not necessarily follow that what is good for one million people on the edge of the modern business world and mainly occupied and dependent upon the cultivation of the soil is equally good both in method and in result for more than forty millions of people, with an industrial population in ratio to that employed on the land of roughly four to one, situated at the hub of world commerce and the centre of concentration of a world-wide competition.

B. C. W.

OUR BOOKSHELF.

Camping in Crete: With Notes upon the Animal and Plant Life of the Island. By Aubyn Trevor-Battye. Including a Description of Certain Caves and their Ancient Deposits. By Dorothea M. A. Bate. Pp. xxi+308+plates. (London: Witherby and Co., 1913.) Price 10*s*. 6*d*. net.

THIS pleasant record of camping experiences in Crete falls into two parts. In the body of his book Mr. Trevor-Battye, who declines to discuss questions of politics and excavations, describes a series of tours through the island. With Canea as his headquarters, he made trips by steamer along parts of the coast, journeyed so far as Sitia on the east, traversed the island to Sphakia, and again to Retimo, with a long and arduous march from Sphakia, *viâ* Mt. Ida, to Candia. The main object of these excursions was the collection of zoological and botanical specimens, many of which have been valuable additions to the South Kensington Museum. He succeeded in bringing home two ibex kids to the Zoological Society, one of which, the male, died from an accident, but the female is now at Regent's Park, and has given birth to twins. He gives a delightful account of these charming animals.

He finds that a narrow waist, which appears in the Minoan frescoes, is quite characteristic of the islanders. He gives useful accounts of the geology, describing the curious high-level plains of Homalo and Nidha, Mt. Ida, and Kurnás, the only lake in the island. He was kindly received by the Turkish officials, the monks, and the villagers. But it is only the most enthusiastic traveller who will risk the privations and difficulties of journeys over breakneck passes.

The appendix is one of much scientific interest. Miss D. M. A. Bate, one of the best authorities on the island, describes the caves, many containing animal remains, and gives a list of the mammals. The birds are catalogued by Mr. Trevor-Battye, who also deals with geology, harbours, agriculture, industries, and ethnology. The book is well illustrated, and is supplied with a good index. This account of the island forms a supplement to the standard authorities—Pashley in 1834 and Spratt in 1865, both of which, with due acknowledgment, are frequently quoted.

The State Provision of Sanatoriums. By Dr. S. V. Pearson. Pp. viii+80+iv plans. (London: Cambridge University Press, 1913.) Price 3*s.* net.

THIS book deals in a practical manner with a subject of considerable interest and importance at the present time. In the earlier chapters the author discusses what is meant by sanatorium treatment, the reasons why the State should provide this, and what other countries are doing in this direction. "Sanatorium" is defined as "an institution in the country for the treatment of resident patients suffering from any form of tuberculosis," and such institutions as farm colonies are excluded. Valuable suggestions are given on the financing, construction (with diagrams), and management of sanatoriums, and the advantages of sanatorium over domiciliary treatment are emphasised.

The author is a strong advocate for the provision of sanatoriums by the State, largely to the exclusion of other forms of treatment. We do not find, however, any estimate given of the number of beds that would be required for the necessary sanatorium treatment of tuberculosis in this country. The State is the trustee of the funds entrusted to it by the taxpayers, and it is the duty of the State to expend those funds to the best advantage of the *community* as a whole. Whether the erection of a number of substantial and costly buildings (the author estimates the cost as at least 170*l.* a bed) all over the country, with their medical and nursing staffs, is really the most efficient and economical way of dealing with the tuberculosis question is a debatable point, and one on which we probably have not sufficient data at present to guide us. It behoves us, therefore, to move warily, and not to launch out into the erection of numbers of sanatoriums, a large proportion of which might hereafter have to be scrapped, and in the meanwhile to improve our domiciliary and dispensary treatment with the adjunct of a certain number of farm colonies and sanatoriums. It must be recognised that tuberculosis is now decreasing, and it is not always remembered that this decline commenced before the institution of any administrative measures against the disease!

Stanford's Geological Atlas of Great Britain and Ireland, with Plates of Characteristic Fossils. By Horace B. Woodward. Third edition. Pp. xii+214. 50 plates. (London: Edward Stanford, Ltd., 1914.) Price 12*s.* 6*d.* net.

THE first edition of this invaluable atlas was reviewed in the issue of NATURE for February 2, 1905 (vol. lxxi., p. 315), and readers may be referred to that notice for particulars of the general characteristics of the volume. The late Mr. Woodward amplified the present edition by an account of the geological features of the Channel Islands and by further descriptions of facts observable along railways in England and Wales. Small corrections have been made, and the maps have been revised.

Bill's School and Mine: a Collection of Essays on Education. By W. S. Franklin. Pp. vii+98. (South Bethlehem, Pennsylvania: Franklin, Macnutt and Charles, 1913.) Price 50 cents, cloth.

MR. FRANKLIN is known on both sides of the Atlantic as the author of useful scientific textbooks, and it is not surprising to find him insisting in his very readable essays upon the value and importance of a training in scientific method in a complete system of education. He quotes Nietzsche as saying: "The time will come when men will think of nothing but education"; it may be hoped that the time will soon be reached when in this country, in addition to thinking about it, people come to believe in it enough to pay sufficient for it to secure competent educators for the next generation.

Heaton's Annual. Tenth Year, 1914. Edited by E. Heaton and J. B. Robinson. (Pp. 590. (Toronto: Heaton's Agency. London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price, British edition, 5*s.*

ATTENTION has been directed on previous occasions to former issues of this useful work of reference, which is described in its sub-title as the "Commercial Handbook of Canada and Boards of Trade Register." The first half of the volume brings together facts about Canada which business men are wanting to refer to continually, and the second contains, among other useful material, up-to-date descriptions of all Canadian towns of any importance.

A Handbook of Wireless Telegraphy: Its Theory and Practice. For the Use of Electrical Engineers, Students, and Operators. By Dr. J. Erskine-Murray. Fifth edition. Revised and enlarged. Pp. xvi+442. (London: Crosby Lockwood and Son, 1914.) Price 10*s.* 6*d.* net.

THE general characters of this valuable handbook were described in the review of the third edition which appeared in the issue of NATURE for August 24, 1911 (vol. lxxxvii., p. 239). The most important additions to the present edition are those concerned with the uniform alternating current and shock excitation systems. Recent measurements of transmitted power have been added also.

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.*]

Alexander Agassiz and the Funafuti Boring.

PROF. POULTON has directed attention (NATURE, February 26, p. 712) to the fact that "very little has been said" concerning the evidence on coral-reef formation obtained by the boring at Funafuti, and he also refers to the views upon the subject held by the late Prof. Alexander Agassiz.

It will be remembered that the very successful borings at Funafuti were carried out by Profs. Sollas and Edgeworth David, and their assistants, under the auspices of the Royal Society, with valuable aid from the Admiralty and the Government of New South Wales. The place for the experiment was selected by a committee of the Royal Society, on which every shade of theoretical opinion was represented, this committee having the invaluable assistance of the late Admiral Wharton, who recommended Funafuti as perhaps the most typical atoll that could be found on the globe.

The very complete set of cores, with all the other materials obtained during these borings, were, by the permission of the Board of Education, received in the geological laboratories of the Royal College of Science at South Kensington, where they were studied by the members of the staff, with the invaluable assistance of Dr. G. J. Hinde, much aid being also given by the officials of the British Museum (Natural History) and of the Geological Survey.

Those who were responsible for the preparation of the report on the undertaking, published by the Royal Society in 1904, felt it to be outside their duty to advocate any particular theory of the origin of coral-reefs; their aim was simply to place on record the evidence obtained; and it may be added that this evidence is always open to examination and criticism from the circumstance that the halves of all the cores are now deposited in the British Museum, with the sections and other specimens, while duplicate halves of the cores have been sent to Sydney University.

During the eight years that the work of studying the materials from Funafuti was in progress, I received many visits from my friend, Prof. Alexander Agassiz, and gladly profited by his advice and suggestions. He showed his confidence in the manner in which the work was being carried on by entrusting to me the materials he collected from the upraised coral-reefs of the Pacific, with the request to have them examined side by side with the Funafuti cores, the result being published at his own expense.

I should not be justified in trying to reproduce the views of Agassiz as communicated to me in our frequent friendly discussions—everyone who knew him will accept my statement that they were always candidly and fairly expressed. But, fortunately, in the work published since his death, his position in the controversy is very clearly indicated. His own researches had demonstrated that, over very considerable areas in the Pacific, elevation, often to the extent of 1000 ft. or more, had taken place. Agassiz maintained that the masses of coral-limestone in the upraised islands—which were much altered, like the limestones in the lower part of the Funafuti boring—were Tertiary rocks, and that the lower cores of Funafuti were of the same age. His views are very clearly illustrated in a diagram reproduced in the "Letters and Recollections," p. 343, together with their relation to the views of others, as understood by himself.

I may add that the most careful study of the Funafuti limestones did not supply any evidence of such a change in the fauna as would justify their being assigned to any of the Tertiary periods. But even if such evidence had been found, the geologist would have been justified in arguing that this would only prove that subsidence had taken place with extreme slowness, or had been subjected to long interruptions. On the other hand, the fact, which Agassiz so fully demonstrated, that certain areas in the Pacific have undergone elevation in recent times, would suggest to every geologist, taking into account what we know of "the warping of the earth's crust," that other areas must simultaneously have been undergoing subsidence, and this was the view maintained by Darwin.

We are entitled then to say that a boring, initiated and carried out under the direction of representatives of all the rival theories on coral-reef formation, was attended with brilliant success. In an island selected as a very typical atoll, the main boring was carried down more than 900 ft. below the lowest depth at which, as all naturalists agree, reef-forming corals can flourish. The materials from top to bottom yielded only those organisms that thrive near the surface of the ocean, often in the position of growth. In opposition to the view that the boring may have penetrated only a talus on the side of the reef, it must be pointed out that two additional borings were made *in the very centre of the lagoon*, which revealed, down to the depth of 100 ft. below their limit of growth, the same reef-forming corals. Finally, in this very typical atoll, all idea of solution going on at the bottom of the lagoon was negatived by the luxuriant masses of the delicate calcareous alga, Halimeda, which, with the thinnest shelled Foraminifera, everywhere abounded in a perfectly uncorroded state.

With Prof. Poulton, then, we may fairly say that while the theory of subsidence is not of "universal application"—and Darwin in all his later writings candidly admitted that such was the case—yet the "validity" of this theory of subsidence is fully established in the case of the only atoll in which the test by boring has been carried out. JOHN W. JUDD.

Kew, February 28.

An X-Ray Absorption Band.

FOR some time past I have been trying to make accurate comparisons of the intensities of the various orders of X-ray spectra reflected by crystals. The purpose of the inquiry is to make experimental tests of the theoretical discussions by Debye and Sommerfeld in relation to the influence of molecular motions upon reflecting power. Of some of their predictions I have found it easy to obtain confirmation which is at least roughly quantitative. For instance, the intensities of the higher order spectra are much more affected by rise of temperature than the lower, and the amount of the change is of the right order of magnitude; also rock salt and sylvine show greater changes than fluorspar.

In one case, however, the results have been puzzling. The relative intensities of the spectra of the diamond at ordinary temperatures are quantities of much importance. Now the diamond which I use is a thin flake which intercepts only a fraction of the incident primary ray, a fraction which diminishes as the diamond is set at a greater angle to the primary beam in order to obtain the higher order reflections. It would appear, therefore, to be necessary to make allowance for this waste of reflection opportunities, a correction which would not be necessary in the case of the other crystals, which are thick enough to intercept all the primary rays. Yet the intensity ratios are, to all appearances, nearly correct before the allowance is made, and become quite wrong afterwards. The diamond behaves as if, like the other crystals, it were quite thick.

I have therefore renewed a search for an effect which I have more than once failed to find, a special absorption of rays which are undergoing reflection. Since the earlier attempts the apparatus has gained in sensitiveness and accuracy, and I now find that the effect is easily visible. That is to say, when the pencil of rays strikes the diamond at the proper angle for reflection there is a diminution in the amount transmitted.

In the experiment as arranged at present a pencil of X-rays from a rhodium bulb passes through a slit one-tenth of a millimetre wide, and falls upon the diamond, which is mounted on the revolving table of the spectrometer. The rays that pass through the diamond fall afterwards upon a crystal of rock salt so placed as to reflect a pencil into the ionisation chamber. When the diamond is turned, a minute of arc at a time, through the angle (about 9°) at which the diamond itself reflects the principal rhodium ray, the intensity of the ray reflected by the rock salt drops in the ratio 100 to 70. No doubt this ratio could be increased by more accurate arrangement.

The principal rhodium ray is really a doublet, the two constituents of which are separated by an angle of four minutes under these arrangements. The doublet is resolved not only in the pencil reflected by the diamond, but also in the absorption band occurring in the reflection from the rock salt.

The effect is no doubt analogous to the selective absorption shown by crystals of chlorate of potash (R. W. Wood, *Phil. Mag.*, July, 1906).

W. H. BRAGG.

The University, Leeds.

Experiments Bearing upon the Origin of Spectra.

IT has been known for some years that a stream of luminous vapour can be distilled away from the mercury arc *in vacuo*, the vapour still remaining luminous when it has passed far beyond the limits of the electric field. It is known also that this luminosity is quenched when the stream passes near a negatively electrified metal surface.

I have from time to time attempted to extend these results to other less volatile metals, and have now succeeded in a large number of cases.

A preliminary account of some of the more significant observations will be given, without dwelling on experimental details.

In the case of sodium under favourable conditions, a very curious behaviour is observed. Where the distilled luminous vapour leaves the lamp, and where, of course, it is most brilliant, the light is yellow, and is dominated by the D lines. Further on, it becomes green, and the lines of the two subordinate series outshine the D lines. Finally, further still, the D lines again predominate. It would seem that if we represent the intensity of each series as dependent on time by a curve, the curve for the principal series will cut that for the subordinate series at two points. It is not, however, easy to find a law of decay which seems physically probable, and will satisfy this condition.

Another interesting effect is seen when the luminous stream is made to pass through a negatively electrified wire net. As in the case of mercury, the glow is partially extinguished. But, if the glow is watched through a spectroscope while the negative potential is applied to the gauze, it is seen that the lines of the subordinate series are far more affected than the D lines.

We may regard the distilled glow as due either to persistent vibration of the luminous centres originally excited in the arc, or to some subsequent interaction occurring in the gas, such as molecular association, or the neutralisation of ions. Whichever view is taken (and neither view is free from difficulty, as I shall show in a more complete publication) we must attribute the action of the electrified gauze to its power of attracting and neutralising positively charged ions. On either view the experiment cited shows that *the systems which gave rise to the subordinate series are not the same as those which give rise to the principal series.*

In the case of potassium, the development of the subordinate series in the distilled glow is very striking, and the existence of a series relation between the lines is visible at a glance, since the series are not confused by extraneous lines. The photography of this spectrum will be undertaken, and it is hoped will lead to an improvement in existing knowledge of the series and their convergence point.

Lastly, I will refer to the behaviour of the glow from magnesium vapour. Initially, the colour is green, dominated by the triplet *b*, and the green band of the "magnesium hydride" spectrum, upon which as a background *b* lies. As the vapour moves on these die out, but the blue flame line at $\lambda 4571$ survives much longer. The vapour was passed through a wire gauze screen. On electrifying this to -40 volts, all the features of the spectrum which have been mentioned were seen to diminish in intensity, but the effect on the blue line and on the bands of magnesium hydride was much stronger than the effect on *b*. The extinction of the band spectrum of magnesium hydride is specially significant.

R. J. STRUTT.

Imperial College of Science, March 9.

Unidirectional Currents within a Carbon Filament Lamp.

THE following experiments are good illustrations of the thermionic current, or Edison effect, in a carbon filament lamp, and require only such apparatus as is usually found in a laboratory.

The type of lamp used is that having two large loops in the filament, with the middle of the loop fixed by a short wire fused in glass at the top of the lamp. If the terminals are earthed and a charged body, either positive or negative, is brought near the lamp, then the two leaves diverge like two leaves of a simple electroscope. The loops may touch the glass bulb, and, if so, they spring back discharged.

But if the lamp is lighted and a pointed rod, connected to a Wimshurst, gives a powerful positive discharge, the loops are not displaced, even if the point is close to the bulb. On the other hand, with a negative discharge, even a foot or two away, the two loops of the filament rapidly and repeatedly strike the glass and spring back. Apparently this action will go on for a long period, if the point of discharge is continued.

The action may be explained from the fact that the lamp acts like a valve, and that the current can pass in one direction only, between the hot filament and the interior of the bulb. There can only be a thermionic current of electrons from the filament to the sides, and when there is an equilibrium distribution the carbon is at a relatively high positive potential compared with the inner wall. If this equilibrium is disturbed, it is adjusted by a thermionic current only, in one direction, or by movement of the loops only, in the other direction.

Thus if the negatively charged plate of an electrophorus is brought towards the lamp, the loops will diverge and strike the sides. Or if the displacement is only partial, the loops will swing back to their original place of rest directly the charged plate is removed to a distance. If, however, the metal disc of the electrophorus, positively charged, is brought towards the still lighted lamp, there is no movement of the loops. Equilibrium of potential is attained by emission of electrons from the filament. But as the disc with its positive charge is being moved away the loops diverge and may strike the glass.

What is most remarkable is this, that if the displacement of the loops is only partial, and not up to the glass, then when the disc is removed, the loops retain their displaced position and very slowly creep back to their original place of rest. It is this last phenomenon which clearly indicates the great difficulty of negative electricity returning to the glowing filament, or of positive ions leaving it.

The Beta rays from a few milligrams of radium near the lamp produce in it an ionisation current which accelerates the creep into a rapid motion, to the natural position of the filament.

These experiments with the electrophorus can all be carried out through a dry wooden drawing-board more than half an inch thick. When projected by a lens on a screen the motions of the filament afford interesting lecture-room illustrations of the thermionic current.

The valve action inside high vacuum lamps was explained by Fleming (Proc. Roy. Soc., 1890, vol. xlvii., p. 122). An account of his work is given in his well-known book on "Electric Wave Telegraphy" (second edition, p. 478).

So far as I know, the experiments described in this letter, with an electric force, produced outside the lamp, have not been previously published.

A. S. EVE.

McGill University, Montreal, January 29.

The Densities of the Planets.

THE prominence you give to M. F. Ollive's note in *Comptes rendus*, tome 157, No. 26, induces me to point out that M. Ollive's so-called empirical formula is really a simple statement about the densities of the planets. The formula is $r^3 = kRR'v'^2$, where r is the mean radius of any planet, R its mean distance from the Sun, R′ the mean distance of any satellite from its primary, and v' the mean orbital velocity of the satellite. v'^2R' for any satellite can be replaced by γM, where γ is the gravitation constant, and M is the mass of its primary, since we can ignore the mass of the planet as compared with its primary. We get then $r^3 = k'RM$, where k' is a new constant. But $M = \frac{4}{3}\pi\rho r^3$ where ρ is the mean density of a planet. Thus we get $R\rho =$ constant. This is what M. Ollive's formula amounts to. In other words, his formula does not derive any generality by the introduction of the satellites. The fact that his results for the various satellites of any given primary agree *inter se* is merely Kepler's third law.

The value of M. Ollive's "empirical" formula is thus to be measured by the extent to which the formula $\rho R =$ constant is true of the planets of the solar system. As it happens, this is at all approximately correct only for Earth, Mars, Jupiter, and Saturn. The densities as generally accepted are, taking the planets from Mercury outwards, 0·85, 0·89, 1·00, 0·71, 0·24, 0·13, 0·22, 0·20. The density of the earth is taken as the standard. M. Ollive's formula gives 2·58, 1·39, 1·00, 0·66, 0·19, 0·10, 0·05, 0·03. It is evident that M. Ollive's "empirical" formula is quite wrong for all but the four planets mentioned, and even for these the agreement is by no means encouraging.

It may be urged that the densities are not observed directly, but are inferred from the masses and the radii of the planets, so that a small inaccuracy in the observed radius of any planet may well account for a considerable error in the inferred density. But I very much doubt whether astronomers will be ready to admit possible errors of 50 per cent. in the radius of Uranus and 100 per cent. for Neptune. They will certainly decline to concede an error of 50 per cent. in the radius of Mercury and of 12 per cent. in the radius of Venus.

SELIG BRODETSKY.

University of Bristol, March 3.

An Optical Representation of Non-Euclidean Geometry.

LET us suppose Euclidean space to be filled with a medium of variable refractive index. Then to an observer in that medium the curved path of a ray of light will present all the appearances of a straight line, and, further, if the observer estimates the distance between two points by the time light takes to pass between them, this path will appear to be the shortest distance between the two points.

Suppose now that one or more such observers conduct an Ordnance Survey of the region occupied by the medium, using theodolites to measure angles, and imagine them to be equipped with instruments capable of measuring the time interval occupied by optical signals in transmission from one station to another, this interval being used as a measure of the distances between the stations. It is clear that these observers will obtain what to them must be a convincing proof that the sum of the three angles of a triangle cannot possibly be always equal to two right angles. And it would not be easy for an individual whose methods of observation of the geometrical properties of such a region were limited to those here assumed to believe that the space in which he lived could contain a Euclidean geometry.

G. H. BRYAN.

NATURE RESERVES.

IT is only too true that man is slowly but surely destroying the beautiful wild animals and plants of the world, and is substituting for them queer domesticated races which suit his convenience and his greed, or else is blasting whole territories with the dirt and deadly refuse of his industries, and converting well-watered forest lands into lifeless deserts by the ravages of his axe. It is not too late to rescue here and there larger and smaller areas from this awful and ceaselessly spreading devastation. In remote lands there are large tracts which may be taken in charge by the local government and rescued from destruction, and to some extent this has been done. Even in our over-crowded European states there are still lovely bits of forest, marsh-land, and down which man has not yet irretrievably befouled, and from which he has not yet driven by assault nor removed by slaughter the beautiful living things which nature has guided and nurtured in their seclusion. There is yet time! Some of these little scattered fragments of our great mother's handiwork can still be preserved even in England, Wales, Scotland, and Ireland, so that future Britons may not utterly curse us, but enjoy, with gratitude to those who saved them, the precious living relics of the world as it was before man destroyed it.

There must be many who have in these days learnt to know the difference between "the country" and the "wilderness," and have discovered the rare and over-powering charm of the latter. The "country," with its manured fields, its well-trimmed hedges, and artificial barriers, its parks planted with foreign trees and shrubs, its roadways stinking of tar and petrol, and its streams converted into chemical drains or else into over-stocked fish-stews, is only rendered less repulsive than the town by the survival here and there of a pond or a copse or a bit of ancient moor-land (happily too swampy for golfers) where nature is still allowed to pursue her own way without the arrogant interference of that prodigiously shameless barbarian, the "civilised" man.

Who does not know the charm of the real wilderness—far from the madding crowd—still accessible, even in southern England, to those in the secret? It is perhaps most directly to be found on a sea-shore bounded by sand dunes and marsh lands, or overhung by rocky cliffs on the untamed summits of which strange plants and legendary birds still linger. It is the real and effective absence of the marplot man which gives its vast beauty and fascination to that world protected by the great sea which is exposed as the tides withdraw from the rocks and pools. Here the passionate lover of nature seeks the unparalleled joy of contact with her, unsullied by human trail. And he finds it, too, in the desolate marshes, the remote sand-wastes of our coasts and estuaries, as well as in the still-surviving moorlands of the north. Plants of many kinds, the insects which depend on them, and timid birds—all of which perish in the presence of civilised man—are still to be seen in these precious and adorable sanctuaries. Even an old-time pond, undisturbed by man's improvements, is for the naturalist who can use the microscope a real "nature-reserve" full of the mystery and beauty of isolation.

It is proposed to secure by purchase or gift the right to preserve from destruction in this country as much and as many as possible of the invaluable surviving haunts of nature. A society has been formed for the promotion of nature reserves. It is in cooperation with societies and individuals having a like purpose in other European countries and in other continents, and has already sent representatives to an international conference recently held at Berne, which was attended by delegates from eighteen countries, and was the means of effecting an important exchange of views as to purposes and methods. The Speaker of the House of Commons is the president of the Society, Mr. Ogilvie Grant and the Hon. F. R. Henley are its secretaries. Its official address is "The Natural History Museum, Cromwell Road," and on its council we find such influential public men as Sir Edward Grey, and Mr. L. V. Harcourt, the two Secretaries of State, and many of our leading naturalists such as Profs. Bayley Balfour, J. B. Farmer, Edward Poulton, Sir David Prain, Sir Francis Darwin, and the Hon. Charles Rothschild.

The main objects of the Society for the Promotion of Nature Reserves, more explicitly stated, are "to collect and collate information as to areas of land in the United Kingdom which retain their primitive conditions; to obtain these areas, and to hand them over to the National Trust, and thus to preserve for posterity as a national possession some part, at least, of our native land, its fauna, flora, and geological features." It is hoped that naturalists and lovers of wild life in every district will keep a watchful eye on primitive and unspoilt tracts, and bring them to the notice of the society by writing to the secretary at Cromwell Road. Often such areas, if sought in good time, may be purchased at a low rate per acre; often local interest and public spirit as well as individual generosity, will facilitate the acquirement of the purchase-money, whilst "the National Trust" has proved itself a capable guardian, and will accept the trusteeship of such "reserves" with the necessary conditions imposed by the Society as to the absolute preservation of their natural conditions. No doubt there may be some care needed in arranging for the occasional admission of visitors to these reserved lands so as to avoid the access to them of too large a concourse, or of persons who are merely bent on holiday frolics—no less than of those who, actuated by the cupidity of the collector, would root out and destroy, under the false pretence of being naturalists and nature-lovers, all the rarer living things, as they have done in so many unprotected spots.

Already a beginning has been made in England. A part of Wicken Fen in Cambridgeshire has been acquired for the nation; also the shingle and salt-marshes of Blakeney in Norfolk. Near Oxford, too, there is a "Ruskin Reserve."

In foreign countries the government has long been active in the way of establishing "reserves," especially where, as in the United States, there are large tracts of uninhabited country. In Germany there is a department of State to control and assist in the preservation of nature, having a very large annual budget. There are already 100 reserves in that country. The yew and the holly are protected in the Government forests, and none may be cut: whilst the service tree is also protected. In this country we have no department of forestry, no knowledge or practice of forestry, and we shall very soon have no forests. The incapacity and want of authority in this subject which has been allowed to grow up in the British official world is lamentable, and was characteristically exhibited in the proceedings of the recent commission on Coast Erosion.

In Germany military exercising grounds and rifle ranges are made into nature reserves so far as is possible and consistent with their military use. The same thing might be, and should be, done in this country. There is no Government department in this country which can either advise or control in such matters. Commons, when taken over by public authority for preservation, should not be utterly drained of water and converted into

London parks, as has been the case at Hampstead, where the small bog above the Leg of Mutton Pond, in which grew the Sun-Dew (Drosera) and the Bog-bean (I used to visit them there!) might well have been left as a bog for the delighted contemplation of London naturalists. There was plenty of dry ground on Hampstead Heath without destroying the bog. There is danger of all such open spaces being converted into a common-place garden or a football field or a golf course unless the new society can extend its protection to them.

The purpose of this article is to invite all lovers of the wilderness, all worshippers of uncontaminated nature, to enter into communication with the Society for the Promotion of Nature Reserves, and see how far they can help in promoting its most worthy national objects.

E. RAY LANKESTER.

P.S.—The following series of inquiries issued by the Society for the Promotion of Nature Reserves will enable the reader to appreciate its purposes and mode of going to work.

Answers will be treated as strictly confidential, and will be at the disposal of the executive committee only. Name of Place. District and county where area is situated. Name and address of society or person giving information. (A) Is the suggested area worthy of permanent preservation as:—(1) A piece of typical primeval country? (2) A breeding-place of one or more scarce creatures? (3) A locality for one or more scarce plants? (4) Showing some section or feature of special geological interest? (B) Is the place recommended primarily for birds, insects, or plants? (1) To whom does it belong? (2) Would the owner be willing to sell, or could the area be leased? (3) Could you get local financial aid should it be considered desirable to acquire the area? (4) Is the place or site locally popular as a pleasure resort? This form should be filled up and returned to the secretary, Society for Promotion of Nature Reserves, c/o Natural History Museum, Cromwell Road, London, S.W.

GOVERNMENT LABORATORY REPORT.[1]

FROM the report of the Government Chemist,[1] issued a short time ago, it appears that the work of the Department increased considerably during the year 1912–13. The total number of samples examined was 209,502, as compared with 195,170 in the previous year.

It is noted that many questions of a consultative and advisory nature, apart from those connected with the examination of samples, are referred to the laboratory by various Government departments. Above 600 such references were dealt with during the year. They included such diverse matters as the causes of the deficiency in the non-fatty solids of milk; the relation between the citric acid solubility and the availability of the phosphates in slags; the selection of suitable denaturants for growing tobacco; stamps for National Health Insurance; and the supply of lime juice to the mercantile marine.

In connection with the attempts to cultivate tobacco and sugar in this country, it is interesting to note that 224 samples of home-grown leaf tobacco were examined, and also specimens of beet-juice, sugar, and molasses from the recently erected beet sugar factory at North Cantley.

Imported dairy produce was generally satisfactory as regards freedom from adulteration. Thus fresh (pasteurised) milk was not below the statutory regulations for quality, and contained no preservatives or artificial colouring substances. Imported butter, of which 1223 specimens were analysed, occasionally contained a small excess of water, but gave no evidence of the presence of fat other than butter fat.

In connection with the supervision of dangerous trades, a large number of lead glazes, dust, and other articles were analysed. From works where lead poisoning had occurred, fifty-eight specimens of lead glaze were taken; in most of these nearly the whole of the lead was in a soluble form, and therefore readily dissolved by the acids of the gastric juice. The principal chemist notes also that important investigations were conducted during the year for the Home Office Committees appointed to consider questions concerning (1) celluloid, and (2) the use of lead compounds in the painting of buildings and coaches.

A large part of the report is devoted to an account of the work done by the laboratory in exercising chemical control over the production and sale of dutiable articles. The account is accompanied by brief outlines of the reasons for this control, and shows how it is exercised. For example, it is explained that the duty on beer brewed in this country is charged on the wort or unfermented saccharine liquid from which the beer is brewed; that the basis of the charge is a statement made by the brewer as to the quantity of materials used and unfermented wort produced, and that the accuracy of this statement can be checked at any time subsequently by analysing the fermented wort. That there is some need for such control is shown by the fact that out of 11,641 samples examined, 1628 were found to have been "declared" at less than their true value. In this and numerous similar ways the laboratory has become an indispensable ancillary of the fiscal departments.

The report shows steady progress of the laboratory, and records a useful year's work.

[1] The Report of the Government Chemist upon the work of the Government Laboratory for the year ended March 31, 1913. (Cd. 7001). Price 3*d*.

NOTES.

THE meeting of the Royal Society on March 19 will be a meeting for discussion, the subject being "The Constitution of the Atom." The discussion will be opened by Sir Ernest Rutherford.

MR. LAURENCE BINYON, assistant-keeper in the British Museum in charge of the sub-department of Oriental Prints and Drawings; Dr. R. M. Burrows, principal of King's College, London; and Mr. A. G. Lyster, president of the Institution of Civil Engineers, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

The death is announced of Mr. John Gott, widely known among telegraph engineers and electricians by his pioneer work in electrical testing and practical telegraphy.

The death is reported, in his forty-seventh year, of Dr. A. H. Pierce, professor of psychology since 1900 at Smith College, Massachusetts. He was editor of the Psychological Bulletin, and author of "Studies in Space Perception."

Dr. W. W. Bailey, professor of botany at Brown University, Rhode Island, from 1881 to 1906, has died at the age of seventy-one. His publications included "Botanical Collector's Handbook," "Among Rhode Island Wild Flowers," "Botanical Note-book," "New England Wild Flowers," and "Botanizing," as well as a volume of poems.

It is announced that the Government will ask the House of Commons to sanction a grant of 13,000*l*. for special investigation into the movements of ice in the North Atlantic. The grant is provided for in the Estimates for Mercantile Marine Services for 1914–15, and represents an increase of 11,000*l*. on the sum voted for this purpose last year.

In the Civil Service Estimates for the year 1914–15, issued a few days ago, it is announced under the head of "Grants in Aid of Scientific Investigation," that the sum of 5000*l*. is to be voted this year towards the expenses of the British Transantarctic Expedition, which Sir Ernest Shackleton is to conduct across the south polar continent. Another 5000*l*. is to be voted next year. This grant of 10,000*l*. forms part of the sum of 50,000*l*., which was already guaranteed before the public announcement of the expedition.

A new magnetic observatory is being established in Swider, near Warsaw, in connection with the magnetic researches now being carried on in Poland by Dr. St. Kalinowski. The observatory will be provided with registering instruments (Adolf Schmidt's system), and for the absolute determinations a large Sartorius magnetic theodolite and an earth inductor will be used. Dr. Kalinowski hopes that the new observatory will be in active operation in the present year.

In accordance with the resolution adopted by the eighteenth International Congress of Americanists, held in London in 1912, the Smithsonian Institution have made arrangements for holding the nineteenth congress in Washington on October 5–10. The organising committee, of which the chairman is Prof. W. H. Holmes, head of the department of anthropology, United States National Museum, has already drawn up a provisional programme. This includes an archæological excursion to the aboriginal quarries and workshops at Piney Branch. A feature of the congress will be an exhibition of rare Americana and other objects and a special exhibition in the museum of the daughters of the American Revolution.

On Tuesday, March 24, Mr. A. H. Smith, keeper of Greek and Roman antiquities in the British Museum, will begin a course of two lectures at the Royal Institution on landscape and natural objects in classical art, and on Thursday, March 26, Dr. C. W. Saleeby will deliver the first of two lectures on the progress of eugenics: (1) "The First Decade, 1904–14," (2) "Eugenics of To-day: its Counterfeits, Powers, and Problems." The Friday evening discourse on March 27 will be delivered by Prof. J. A. Fleming on improvements in long-distance telephony, and on April 3 by Sir J. J. Thomson on further researches on positive rays.

Prof. E. Naville, in the *Times* of March 6, describes a remarkable discovery in the course of excavation at Abydos. Strabo, in his account of what he calls the "Fountain of Abydos," speaks of a labyrinth with covered ways roofed with enormous slabs resting on pillars. Two gigantic colonnades have now been discovered not far from Seti's temple, leading into a great hall, now empty, as it has been a quarry for centuries. The texts, however, which survive on the walls, copies of the Book of the Underworld, show that this was the famous tomb of Osiris. Like the pyramids in the case of the monarchs of Egypt, this splendid building was a fitting tomb for a god. What has become of his body, whether only his head was preserved, whether the remains were enclosed in a sarcophagus—we shall probably never know.

The Army Estimates for 1914–15 provide a million pounds sterling for the air service, of which nearly 200,000*l*. is for buildings. Colonel Seely's memorandum on the Estimates points out that good progress has been made during the past year with the development of the Military Wing of the Royal Flying Corps. By the end of this month the number of officer fliers will have grown to about two hundred. During the past year an Inspection Department for Aviation has been formed and is finding much scope for its activities in inspecting new supplies of all kinds, and also in overhauling periodically the aeroplanes, engines, and so on of the flying squadrons. A special section of the Army Ordnance Department is also about to be formed to deal with the storage and supply of the highly technical and complicated *matériel* used in this branch of the service. As a general indication of the progress made in the past year, it may be said that, as compared with 100 aeroplanes in existence on March 20, 1913, there were on February 25 last 161 on hand, and between those dates 87 had been struck off as unserviceable and replaced.

Some of the recent work at Rothamsted in connection with the partial sterilisation of soils has found application in the Lea Valley district just north of London, where a great market garden and glasshouse industry flourishes. So much interest has been aroused among the growers that they have banded themselves together to form an Experiment Station where the various problems arising out of the industry can be investigated in a scientific manner, and where advice may be obtained as to plant diseases, pests, and so on. The growers have raised a large sum of money among themselves for the erection and maintenance of the station, and, in addition, a substantial Government grant has been made, and the county councils have also contributed; the financial success of the scheme therefore seems assured. The problems to be investigated are of great technical importance and high scientific interest. A strong committee of management has been formed, one-half being practical growers, and the other half men of science nominated by the committee of the Rothamsted Experimental Station. The scientific side of the work will, therefore, be amply represented, and there is every prospect that a sound programme of work will be drawn up.

Mr. G. Marconi delivered a lecture in Rome on March 3 before the King and Queen of Italy, members of the Italian Government, both Houses of Parliament, and the Diplomatic Corps. He described the progress which had been made in wireless telegraphy, and the difficulties which had been overcome since his previous lecture in Rome in 1903. His voyage to South America on board the *Principessa Mefalda* had illustrated that communication in a north and south direction was easier than communication in an east and west direction. Mr. Marconi described his new system for generating continuous waves, and its use in wireless telephony. He then described the apparatus for producing waves, divided into regular groups, and dealt with the improvements effected in receivers, giving a practical demonstration of the reception of messages in the lecture hall from Poldhu, in Cornwall, and Tripoli. Mr. Marconi finally described the practical applications of radio-telegraphy to all types of vessels, including submarines, as well as its uses in war and peace. He concluded with an acknowledgment of the help which he had received from the King and Queen of Italy.

An appeal on behalf of the Alfred Russel Wallace Memorial Fund, signed by the executive officers, Prof. R. Meldola, Prof. E. B. Poulton, and Mr. James Marchant, was published in the issue of Nature for December 11 last (vol. xcii., p. 425). If a sufficient sum can be raised, the following memorials are proposed:—(1) A memorial medallion for Westminster Abbey, to which the Dean and Chapter have given their consent; (2) a portrait; (3) a copy of the portrait for presentation to the nation; and (4) a statue to be offered to the trustees of the British Museum for erection in the Natural History Museum. It is estimated that the complete scheme can be carried out for 1100*l.* The subscriptions received or promised amount to 200*l.* The medallion for Westminster Abbey will, it is estimated, necessitate the expenditure of at least 300*l.*, and the executive committee is anxious to complete this part of the work as soon as possible. The second part of the scheme, the portrait, will be proceeded with as soon as an additional sum of 350*l.* is subscribed. The most convenient course for intending subscribers to adopt is to send cheques made payable to the "Alfred Russel Wallace Memorial Fund," to the manager, Union of London and Smith's Bank, Holborn Circus, London, E.C. It is earnestly to be hoped that a sufficient response to the appeal will be speedily forthcoming to enable the executive officers to complete what will be worthy memorials of a great naturalist.

The report of the council of the Physical Society (adopted at the annual general meeting on February 13) states that owing to the improved financial position it is felt that the society's field of activity should be increased; careful consideration has, therefore, been given, during the past year, to the possibility of introducing new features, such as the issue, from time to time, of reports upon certain subjects of general interest. The first subject selected for the purpose is radiation. Mr. J. H. Jeans, F.R.S., has expressed his willingness to write the report upon this subject, and to have it complete during the summer. An occasional or annual lecture by some eminent physicist will also be arranged. This series of lectures, the first of which will be found summarised elsewhere in this issue, will be known as the Guthrie Lectures, in memory of the late Prof. F. Guthrie, through whose efforts the society was founded. A committee has been appointed by the council to consider questions in regard to nomenclature and symbols and allied matters, and consists of Prof. H. L. Callendar, Mr. A. Campbell, Dr. C. Chree, Dr. W. Eccles, Prof. G. Carey Foster, Sir George Greenhill, Dr. A. Russell, Prof. the Hon. R. J. Strutt, Prof. S. P. Thompson, and Prof. W. Watson, with Dr. Eccles as secretary and convener. At present the committee is discussing electric and magnetic quantities; but reports on mathematical and mechanical nomenclature and symbols, so far as these concern physicists, and on heat are also projected.

A summary of the weather for the past winter in the several districts of the United Kingdom, as shown by the results for the thirteen weeks ended February 28, has been issued by the Meteorological Office. The mean temperature for the whole period was above the average over the whole of the British Isles, the excess being greatest in the English districts. The highest temperature in any district was 61° in the midland counties, and the lowest reading 5° in the east of Scotland. In the north-east of England the lowest winter temperature fell to 9°, and in all other districts it fell below 20°, except in the English Channel district, where the lowest reading was 25°. The summary shows the rainfall to be less than the average except in the north of Scotland and the north of Ireland; the greatest deficiency was 2·15 in. in the midland counties, where the total rainfall was only 67 per cent. of the average. In the north-east of England the rainfall was 70 per cent. of the average, in the east of England 75 per cent., and in the south-west of England 86 per cent. of the average. The greatest aggregate measurement for the winter was 19·16 in. in the north of Scotland, and the least measurement 3·83 in. in the north-east of England. There was a deficiency in the number of rainy days in all the English districts. The duration of bright sunshine was deficient over the entire kingdom, except in the south-east of England, where, however, the excess was very slight.

In the Annals of the South African Museum, vol. xiii., part i., Mr. L. Péringuey, the director, gives an interesting list of inscriptions left by early European navigators to the East in South Africa. The earliest inscribed stone is that of Diego Cão, A.D. 1484. This was found in German territory in 1893. By orders of the German Emperor, the original has been removed to Germany; one replica has been erected on the spot where the original stood, and a second has been promised by the German authorities to the South African Museum. The first English record is that of Antony Hippon, mate or master of the *Hector*, dated in 1605. The next is that of the *Thomas* in 1618. The paper throws new and interesting light on the early history of European discoveries in the East, and the evidence now provided will be useful for comparison with the early records in the India Office.

The University Museum of Philadelphia has started an interesting experiment for the study of some Indian tribes. Mr. L. Shotridge, a full-blood Tlinget, from the Chilkat river in south-eastern Alaska, has been appointed an assistant on the museum staff. He has made for the museum a model of a section of his native village, and in this article, in the issue of the journal of the museum for September, 1913, he gives a detailed account, with plans, of the methods of house-construction. Those of chiefs are sometimes elaborately decorated, and are looked on with respect, because in them are kept the old relics—ceremonial costumes, helmets, batons, carved and painted screens and posts—which have come down from the family ancestor. The house drawings are interesting as showing the methods of native architecture and carpentry.

No. 6 of the fourth volume of the Journal of the College of Agriculture of Tokyo is devoted to an account by Mr. Tsunekata Miyaké of the Japanese insects of the neuropterous group Mecoptera, a group of which Japan is already known to possess more than forty species, while Europe and America collectively do not own more than twenty. It was at one time supposed that these insects, as typified by Panorpa, were of value to agriculturists on account of their destroying other insects, but their importance in this respect appears to have been overrated.

The receipt of a copy of the February issue affords a welcome opportunity of bearing testimony to the high standard of excellence attained, both from the zoological and the artistic point of view, of Mr. Douglas English's illustrated monthly journal, *Wild Life*, which has now entered its third volume. Among the contents of the present issue an article by Mr. C. J. King on the grey seal in the Scilly Isles, illustrated by photographs showing the wonderful difference between the coat of the new-born young and half-grown individuals, is one of the most interesting. Attention may also be directed to the photograph by Mr. Seth Smith of the male pigmy hippopotamus recently presented to the Zoological Society by the Duke of Bedford, which, although taken when the animal was too much in the shade, serves to show the small head, slender limbs, and widely separated toes distinctive of the species. The society now possesses a pair of these rare animals.

The Transactions of the Royal Scottish Arboricultural Society, vol. xxviii., part 1 (January, 1914), contain the concluding part of Mr. A. D. Hopkinson's account of the State forests of Saxony, which are perhaps the best managed in Europe, being worked upon a strictly commercial basis. These forests, with an area of 426,105 acres, yielded in 1910 a gross return of 790,753*l.*, from which, if the working expenses, 327,869*l.*, are deducted, there remains a net annual revenue of 462,885*l.*, or 1*l.* 1*s.* 9*d.* an acre. The expenses comprise cost of administration, maintenance of roads and buildings, cost of felling and planting, etc., and include also such items as 1044*l.* for research work, and 8035*l.* for insurance of workmen. The main species in cultivation is spruce, which is felled at an age of eighty years. Of special interest to plant ecologists is Mr. G. P. Gordon's article on the different associations constituting the beautiful natural forest of the Zernez district in the Engadine, which has lately been made a nature reserve by the Swiss Government. Continental forestry is further dealt with in the official account of the visit of the society to Switzerland in July, 1913, and by numerous notes on the forests of France and southern Germany. The main article on home forestry deals in a practical way with the successful planting of a considerable tract of high-lying peat at Corrour, in Inverness-shire. The method adopted is a Belgian one, which was introduced by Sir John Stirling-Maxwell in 1908.

There seems to be some probability of more unfavourable ice conditions in the North Atlantic this year than existed during 1913. Although bergs were sighted throughout the whole of that year, they were comparatively few in number, and of small dimensions on the Transatlantic routes. The meteorological charts of that ocean for the present month published by the Meteorological Office and by the Deutsche Seewarte contain useful notes upon the subject. Bergs were seen at Belleisle early in January last, and also several about 46° N., between 46° and 49° W. On January 30, in 48·2° N. and 48·7° W., the steamer *Czar* had to alter her course considerably to get clear of field ice, and some ships bound for Canada have had, owing to unfavourable ice conditions, to take to the more southerly route before the usual time agreed upon. There was much ice on the west coast of Iceland in the early part of January, and several trawlers are reported to have received damage.

A bibliography of the Antarctic, from the earliest works to 1913, by J. Denucé, forms a bulky appendix to the thin report of the International Polar Commission held at Rome in April, 1913 (Bruxelles: Hayez, 1913). The first outcome of the ambitious projects of this scheme was the "Liste des Expéditions Polaires depuis 1800," compiled in 1908 by the same author, and republished in a revised form in 1911. The present bibliography is excellently arranged under various subjects, and in cases where the entries are numerous, a regional subdivision has been adopted. The entries under each heading are in chronological order, and classified with an index number on the decimal system. The division of the Antarctic into four equal quadrants is a mistake, as it results in the partition of the Ross Sea, but any scheme of division must have its drawbacks, especially as the isolated known areas become linked by further exploration. M. Denucé has founded his work on the polar library which the commission is trying to form in Brussels, but he has gone far beyond the scope of that collection, and has spread his net wide enough to include various important reviews of Antarctic works, many newspaper articles, and notes in geographical publications, some of which inevitably would be lost sight of but for a careful compilation of this kind. On the other hand, there is room for revision and additions. We have noted a few omissions, and some slight errors in references, besides the premature inclusion of some papers announced, but not yet published. However, M. Denucé's work is a welcome supplement to Dr. H. R. Mill's bibliography in the "Antarctic Manual" of 1901.

THE symbol $|x|$ as applied to real quantities denotes the numerical value of x irrespective of algebraic sign. In a recent paper (Moscow: I. N. Kouchnéreff and Co., 1913), Dr. D. Riabouchinsky, director of the aerodynamic institute of Koutchino, treats this quantity as a function of the variable x, and shows how this method leads to interesting formulæ involving the solution of equations, differentiation, and integration. A number of elegant geometrical applications are also given, such as equations of broken lines, and equations of limited portions of planes, such as a square area.

THE first number of the *Washington University Studies* contains an interesting paper by Mr. Benjamin M. Duggar on Lycopersicin, the red pigment of the tomato, and the effects of conditions on its development. This red pigment is partially or completely suppressed when green fruits are ripened at a temperature of 30° C. or above, the inhibition of reddening being proportional to the temperature above this point. The factors for reddening are not destroyed by high temperatures, and a return of the fruit to normal conditions causes rapid pigmentation. The presence of oxygen is necessary to bring about reddening, and fruits maintained in an oxygen-free atmosphere fail to redden at the normal ripening temperature. The colouring matter of the red peppers and of the arils of Momordica exhibit the absorption bands of Lycopersicin.

THE *Photographic Journal* for February contains a condensed account prepared by Mr. F. F. Renwick of Dr. H. Ewest's thesis on quantitative spectrophotography. After giving a short account of most of the methods used previously, the author gives a description of his own apparatus, and the tests he has made in order to see that it is capable of giving trustworthy results. The light from a Nernst lamp is condensed on the slit of a direct-vision spectroscope, and the spectrum is produced on the photographic plate to be tested. Immediately in front of the plate is a neutral Goldberg absorbing wedge which covers the whole plate, and is raised with the plate at a uniform rate. The curve separating the opaque from the transparent portion of the negative then allows the character of the plate to be determined, and the relations between the time of exposure, the intensity of the light, and the density of the negative in all parts of the spectrum to be investigated. The method seems convenient and trustworthy, and should lead to an extension of our knowledge in this field.

AN important paper on the nature of enzyme action by Mr. Hendrik S. Barendrecht appears in the *Biochemical Journal* (vol. vii., part 6). In this paper, which bears the title, "Enzyme Action, Facts and Theory," it is pointed out that the researches of the past few years on the kinetics of enzyme action have brought more confusion than clearness into this field. An attempt is made by Mr. Barendrecht to clear up some of the contradictory statements regarding the kinetics of some of the most simple enzyme actions. As a working hypothesis it is assumed that enzyme action spreads like a radiation from an enzyme particle as centre; this conception is developed mathematically for the cases of more or less concentrated solution of the substrate, and the effect is considered of the products of the action exercising an absorption on the active radiations, and hence on the velocity of the change. In this way velocity equations are derived, which explain certain cases which have appeared to be abnormal. In particular the special cases of the action of invertase on cane sugar, of lactase on milk sugar, and of maltase on maltose are considered, with especial reference to the effect of the resulting sugars on the velocity constants.

IN the course of an interesting and suggestive paper on the calculations and details for steel-frame buildings, read at the Concrete Institute on February 26, Mr. W. Cyril Cocking urged that all constructional engineers and draughtsmen should support the London Building Acts 1909 Amendment. It may be thought by some that certain amendments to the Act would be desirable, but no concessions can be expected unless all concerned with its working combine to make the best of it as at present framed. Time has shown already that the Act has been the means of improving considerably the general design of steelwork. The 1909 amendment is an Engineer's Act essentially, and the reinforced concrete regulations will be more so, and it seems within the possibilities of the near future that, provided the engineer takes advantage of his opportunities, he might assume the more important position—the architect then confining his attention solely to the architectural treatment. Whole-hearted cooperation between engineer and architect will tend to provide London with buildings in which the architecture is more fully developed, and combined with sound construction in such a manner that the demands of economy and scientific utility are satisfied fully.

A GENERAL discussion on every aspect of the passivity of metals was held at the meeting of the Faraday Society on November 12 last, and was reported in the issue of NATURE for November 20, 1913 (vol. xcii., p. 356). The eight papers read on that occasion, together with the discussion upon them, have now been reprinted from the Transactions of the Faraday Society in book form, and can be obtained at the price of 7*s*. 6*d*.

The following books relating to science are announced, in addition to those referred to in our issue of March 5:—In *Anthropology*—The Ban of the Bori: an Account of Demons and Demon-Dancing in West and North Africa, Major A. J. N. Tremearne, illustrated (Heath, Cranton, and Ouseley); in *Biology*—The Wonder of Life, Prof. J. A. Thomson, illustrated (A. Melrose, Ltd.); In Nature's Ways, M. Woodward, illustrated (C. A. Pearson, Ltd.); British Flowering Plants, illustrated by Mrs. H. Perrin, with descriptive notes and an introduction by Prof. Boulger, 4 vols. (B. Quaritch); in *Chemistry*—Chemical Lecture Diagrams, Dr. G. Martin; The Wonderland of Modern Chemistry, Dr. G. Martin, illustrated (Sampson Low and Co., Ltd.); Elements of Physical Chemistry, J. L. R. Morgan, new edition (New York: J. Wiley and Sons, Inc.); in *Engineering*—Modern Practice in Tunnelling, D. W. Brunton and J. A. Davis; Subaqueous Foundations, C. E. Fowler; Influence Lines for the Determination of Maximum Moments in Beams and Trusses, M. A. Howe (New York: J. Wiley and Sons, Inc.); in *Geography and Travel*—Sport and Science on the Sino-Mongolian Frontier, A. de C. Sowerby (A. Melrose, Ltd.); Hunting and Hunted in the Belgian Congo, R. D. Cooper, illustrated; South Polar Times, reproduced in facsimile, new volume (Smith, Elder and Co.); in *Geology*—A.B.C. of the Useful Minerals, A. McLeod; Engineering Geology, H. Ries and T. L. Watson (New York: J. Wiley and Sons, Inc.); in *Mathematical and Physical Science*—Science and Method, H. Poincaré, translated by F. Maitland (T. Nelson and Sons); The Stars Night by Night, J. H. Elgie, illustrated (C. A. Pearson, Ltd.); Meteorological Treatise, F. H. Bigelow; Theory of Numbers, R. D. Carmichael; Elementary Theory of Equations, L. E. Dickson; Invariants, L. E. Dickson (New York: J. Wiley and Sons, Inc.); in *Medical Science*—Industrial Gas Poisoning, Prof. Glaister and Dr. D. D. Logan (E. and S. Livingstone).

OUR ASTRONOMICAL COLUMN.

Comet 1913*f* (Delavan).—In this column for February 12 we gave the ephemeris of comet 1913*f*, discovered by Delavan, which was computed by Dr. G. van Biesbroeck. This ephemeris is now continued here for the rest of the month so far as it is published:—

oh. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
March 13	2 47 21	+5 53·6	10·7
17	49 27	6 38·5	10·7
21	51 44	7 23·7	10·7
25	2 54 12	+8 9·2	10·6

The magnitudes are based on the assumption that the comet was of magnitude 11·0 on December 17. The current number of the Lick Observatory Bulletin (No. 250) contains another computation of the parabolic elements of this comet undertaken by Messrs. S. Einarsson and S. B. Nicholson, and an ephemeris based on those elements by Miss Julia I. Mackay and Mr. C. D. Shane, of the same institution. The elements are very closely similar to those calculated by Dr. Biesbroeck, and the ephemeris differs only slightly. According to the last-mentioned computers, it is stated that assuming the brightness of the comet to have been 1·00 on December 29 of last year the comet may become visible to the naked eye.

On the other hand, M. R. Goudey contributes to the *Astronomische Nachrichten* (No. 4717) elliptic elements of the above comet based on observations extending between December 18, 1913, and January 15 of the present year. The position he gives in his ephemeris for March 21 is almost identical with that stated in the foregoing table.

A Large Reflector for Canada.—It is very satisfactory to be able to record that Canada will soon be equipped with a fine large reflecting telescope, contracts having been given for its construction. When it is mentioned that Messrs. J. A. Brashear and Co. will be responsible for the optical parts, and Messrs. Warner and Swasey Co. for the mounting, the well-known capabilities of these firms should certainly secure a fine instrument. Prof. J. S. Plaskett is to be congratulated on the successful issue of his endeavour to secure an instrument of large aperture for Canada, and his account of the proposed form of mounting, programme of work, etc., contributed to the current number of the Journal of the Royal Astronomical Society of Canada will be read with interest. The telescope will have a parabolic mirror of 72 in. clear aperture, with a central hole of 10 in., the focal length being 30 ft.; it is to be mounted similarly to the Melbourne reflector. It will be primarily used for spectrographic observations of stellar radial velocities, but it is planned to have the telescope available for the direct photography of nebulæ, clusters, etc. One of the principal considerations in the design is to enable work "to be done in the most efficient and convenient way possible with the simplest possible mechanical design." The communication in question describes in detail the simplifications with which it is intended the instrument shall be equipped.

The Smithsonian Astrophysical Observatory.—The report of the Astrophysical Observatory for 1913, under the direction of the Smithsonian Institution, contains a good account of progress made; in fact, the director, Mr. Abbot, refers to the work of the observatory as "uncommonly successful." We notice that for the solar work at Mount Wilson there has just been erected a Tower telescope, 40 ft. high, for use with the spectrobolometer, for the study of the distribution of radiation over the sun's disc. The report states many results of the year's work. Thus the mean value of the solar constant of radiation at the earth's mean distance from the sun, from about 700 observations made at high and low stations between 1902 and 1912 is 1·932 calories per square centimetre per minute. The fluctuation of the "solar constant" values is attributed to the variability of the sun, and in addition to the periodicity due to sun-spots, there is another "irregular, non-periodic variation, sometimes running its course in a week or ten days, at other times in longer periods and varying over irregular fluctuations of from 2 to 10 per cent. of the total radiation in magnitude." Further, a combination of the effects of sun-spots and volcanic haze is put forward as explaining the principal outstanding irregularities in the temperature of the earth for the last thirty years. Finally, in the Californian expedition, in which sounding balloons were employed, the solar radiation values at very high altitudes indicate that the direct pyrohelion metric observations gave results of the same order of magnitude as the solar constant work of 1902–12 by high and low sun observations on homogeneous rays, according to Langley's methods.

THE IMPORTATION OF BIRDS' PLUMAGE.

TO the *Fortnightly Review* for March Miss L. Gardiner contributes, under the title, "The Fight for the Birds," a timely article apropos of Mr. Hobhouse's Plumage Bill now down for second reading. She gives a history of the rise and progress of the contest against the slaughter and extermination of so many of the most useful and ornate birds of the world for the plumassier trade, which has never been more in evidence than in the past season or two, during which women have "so gaily worn the brand of Cain in the street." Miss Gardiner quotes statistics from brokers' catalogues, mainly of 1911, 1912, 1913, which show that, besides others, 132,000 "ospreys" were killed, 8700 birds of paradise, 22,000 crowned pigeons, 24,000 humming-birds, 23,000 terns, 162,000 kingfishers, 1200 emeus, and 4500 condors. It is significant that, as the author remarks, "reports on the quantities now sold are no longer published in the *Public Ledger* since the House of Lords inquiry."

The outcry against this wholesale slaughter is not confined to the lovers of nature and the humanitarians as such, but is loud from the agriculturists of the Himalayas, of Madras, and other parts of India, of Georgia, Florida, and Carolina, and of Egypt, whose crops are devastated by reason of the scarcity of the birds that heretofore destroyed the insect pests now ruining them. Strong official support has been given by the Zoological Society to Mr. Hobhouse's Bill, and also by the British Ornithologists' Union, although the trade journals claim both societies, as well as quote the names of numerous distinguished scientific men, many of whose names were authorised under the impression that they were supporting the principle of the Bill—as in favour, not of the Bill, but as supporters of the Committee for the Economic Preservation of Birds. Unfortunately, the Zoological Society has been made to appear to the general public to support the Economic Committee—to which it is absolutely hostile—through the secretary of the society having accepted, in his private capacity, the chairmanship of the committee. The corresponding Economic Committee in Paris, as recorded recently in NATURE (January 29, p. 617), was entirely defeated on its very strenuous attempts to check the growing force of opinion in France in favour of the protection of birds, fostered by the Acclimatisation Society.

Miss Gardiner's article should be widely studied by all who desire to know the rights and wrongs of the plumage traffic. In a letter "On the Need for Protection of Rare Birds," in the *Times* for March 3, the Hon. Charles Rothschild says he is impelled to write "as there is a danger of the [Plumage (Prohibition)] Bill being defeated through the efforts of those opposed to the measure, who have formed themselves into . . . the Committee for the Economic Preservation of Birds." His observations fully corroborate what Miss Gardiner has stated about the objects of this committee in the *Fortnightly Review*. "One thing is certain," as Mr. Rothschild remarks, "that many of the most beautiful birds have never been in greater need of protection than at the present time. In the *Times* of March 6 Mr. C. F. Downham, replying to Mr. Rothschild, trails once more the red-herring of the "dead" egret feathers across the question. It has been abundantly proved that the plumes offered as "dead" were wrongly so described to quieten public opinion; and if, indeed, any "dead" feathers now come to the market, they are brought with the same object, and for the reason that the supply from slaughtered birds has decreased below the demand, not "because the area of protection is increasing," but because the heronries themselves have been so depopulated. It is amusing to read Mr. Downham's statement that "the nuptial plumes of the egret are borne by the birds long after the nesting time, and that the birds carry their feathers for seven or eight months of the year."

In the March issue of *Pearson's Magazine* Mr. Hesketh-Pritchard describes the almost incredible cruelties perpetrated by the professional plume-hunters, the sworn testimony of one of whom he quotes, which is directly contradictory of the plume-traders' reiterated declarations that the "egrets" are moulted feathers. The *Spectator* of March 7 has also a powerful article on the need for the Plumage Bill, from which the following sentences are extracted:—". . . the activities of the [economic] committee appear at present to be centred hardly so much on the protection of birds which are being harassed, as upon definite opposition to the Bill which prohibits the importation of their plumage. . . . The plumage of all birds is at its brightest in the breeding season, and it is at this season, therefore, that the bird is killed. No 'economic preservation' will alter that fact. The plain issue, in short, is . . . whether traffic in feathers which admittedly involves cruelty and which leads inevitably towards the extinction of species shall be permitted at all. So far as Great Britain is concerned, we hope that a Plumage Act will be the answer."

A public meeting will be held at Caxton Hall, on Thursday, March 19, at 5.30, under the patronage of the Royal Society for the Protection of Birds, the Zoological Society, the Avicultural Society, the British Ornithologists' Union, the Society for the Promotion of Nature Reserves, the Society for the Preservation of the Wild Fauna of the Empire, and other bodies, in support of the Plumage Bill. When the Bill is passed it will be illegal to import the feathers or skins except for scientific purposes, for which purpose a licence will be obtainable from the Board of Trade. It is confidently believed that such legislation will have far-reaching effects towards the preservation of rare and beautiful wild birds. The trade in ostrich feathers is specially exempted from the provisions of the Bill. Tickets (free) for the meeting may be obtained through the secretaries of the patron societies, or from the hon sec., Plumage Meeting, 34 Denison House, Westminster.

THE VITAMINES OF FOOD.[1]

FLEURENT, in his "Le pain de Froment," shows that the grain of wheat consists, by weight, of the protective coat (15·6 per cent.), the embryo or germ of millers (1·4 per cent.), and the white flour (83 per cent.). The coat includes, in addition to the pericarp and testa, the aleurone layer of the endosperm, the remainder of which forms white flour. The bran of the miller, as removed by the metallic roller, includes the aleurone layer, which is not only a starchless layer, rich in fats, but contains the newly discovered bodies to which C. Funk has given the name of vitamines, and of which the first detailed authoritative account has appeared this year ("Die Vitamine," von Casimir Funk, J. F. Bergman, Wiesbaden, 1914).

A discussion of their chemical nature would be out of place now, and must be left to organic chemists. It may be mentioned, however, that they do not contain phosphorus, they are not fatty bodies, and are distinct from lipoids. They are nitrogenous and of highly complex structure (*e.g.* the formula of one is $C_{26}H_{20}O_9N_4$); they are indispensable for

[1] Summary of a lecture entitled a "Grain of Wheat," delivered in the National Museum, Dublin, on February 24, by Prof. T. Johnson.

life, and no diet is complete without them. If the brain, "one of the three legs of the tripod of life," is starved by a vitamineless diet troubles of all kinds—called by Funk *deficiency diseases*—arise, and these may end in death. The muscles dwindle away, the nerves degenerate, and heart and bone troubles result. Their absence is a predisposing cause of tuberculosis. Vitamines are found in plants, and especially in their seeds. So far as is known at present, animals are incapable of making them. Animals, however, obtain them by feeding on plants. Thus vitamines occur normally in meat, fresh milk, and yolk of egg. They are soluble in water, and insoluble, mostly, in ether. They are thermolabile, and are destroyed by exposure for 10–20 minutes to a temperature of 120°–130° C., as well as by extreme dryness. Thus cattle may, following on a long drought, suffer from a vitamineless fodder.

Funk regards vitamines as the mother-substance of ferments and hormones, and of vital importance to the thyroid and other ductless glands. It is thus evident that the diet standards of the text-books must be revised in the light of their discovery, which throws a flood of light on the milk and other food problems. White flours and corn flours are deficient foods because the vitamines have been removed in the milling process.

Wherever any cereal, robbed of its aleurone or vitamine layer, forms the chief food of a people, there a deficiency disease appears. Rice is eaten by more people than any other grain, in the tropical regions of both hemispheres. The marked increase of beri-beri caused by eating *polished* rice, claiming thousands of victims yearly in Japan, etc., coincides with the replacement of the primitive whole-grain stone-milling by the modern steel roller. The United States Government has already made the polishing of rice in the Philippines illegal. Indian corn (*Zea mais*) is largely eaten in north Italy, the Balkan provinces, the southern part of the United States, Brazil, etc. In all these countries pellagra, which affects the skin, digestive organs, and mental powers, is prevalent. The disease could be stamped out by adding to the diet potatoes, one of the cheapest and most practical sources of vitamines. Though the tax of 32*s*. 6*d*. a ton on potatoes has been removed, the U.S. Government has at the same time closed its ports to European potatoes, as a precaution against the introduction of potato diseases, such as Spongospora, though pellagra is on the increase, and American potatoes are becoming dearer.

Rickets, scurvy, osteomalazia, etc., are also deficiency diseases caused by the use, as the main articles of diet, of such vitamineless foods as sterilised milk, condensed milk, cornflours, starch, and sugar. The mixed diet of most people protects them from deficiency diseases.

Vitaminous foods are fresh milk and (though less rich in them) pasteurised milk, whole grains, potatoes, carrots, and other fresh vegetables, lime and other fruit juices, beans, peas, lentils, and the like, meat, beef-tea, barley-water, yeast, and apparently cod liver oil The discovery of vitamines leaves the vexed question of the relative values of white bread, standard bread, etc., where it was, as the heat of the oven, far above that of the autoclave in milk sterilisation, probably destroys the vitamines of the wholemeal bread.

Phaseolus mungo. L. (*P. radiatus*, L.), added to polished rice effectively supplies the removed vitamines, prevents beri-beri, and has long been regarded by the Chinese as a delicacy in the form of vermicelli. A yeast extract is already available for a similar purpose in this climate.

ATMOSPHERIC REFRACTION AND GEODETIC MEASUREMENTS.[1]

AMONGST the many perplexing problems with which geographical surveyors have to deal those which concern the determination of altitude are not the least. For purposes of practical ability, such as the levelling of roads or the laying out of contours and gradients where differential altitude is comparatively small and progressive, existing methods are quite sufficiently scientific and accurate. It is in the determination of the relative altitudes of large geographical features, where angular measurements become necessary, that there arises a series of complications due to variations in the amount and effect of refraction, or in that of the plumb-line deflection, which have been by no means exhaustively investigated, and which introduce errors of an appreciable quantity. These errors are seldom of large practical importance, so that an investigation into their origin and the scientific methods of their dispersion is more or less matter of academic interest to that limited public which concerns itself with mountain altitudes and is generally content to accept the reading of a cheap aneroid as sufficient proof of the correctness of a value determined by triangulation.

By the scientific geodesist, however, Mr. Hunter's investigations will be warmly appreciated. The book before us is No. 14 of the Professional Papers of the Survey of India, and it contains a careful analysis of the chief sources of error which beset the ordinary estimates of the amount and effect of terrestrial refraction. The error due to refraction is usually disposed of by the assumption that the angle of refraction bears a constant ratio to the angle contained by the ray of observation at the centre of the earth. When reciprocal observations can be taken (*i.e.* from A to B, and from B to A) this ratio can be determined, and it is then recorded as the "coefficient of refraction," and is applied to other observations which, not being reciprocal, require to be corrected for the effect of refraction. This method Mr. Hunter calls a "makeshift," and it is with the object of putting the consideration of "angular measurements affected by terrestrial refraction on a more accurate and scientific basis," that he has deduced formulæ from his investigation which, in the concrete form of tabulated corrections, may assist in dispersing the errors arising from variations in the density, temperature, and atmospheric pressure of the air between the station of observation and the point observed. The only assumption which he makes is the natural one that "layers of equal density in the air are concentric with the (circular) section of the earth in the azimuth of the ray," an assumption which includes that of thermal equilibrium. The formulæ derived in chap. i. show that refraction depends very largely on the rate at which temperature changes with the height, and with the change of this rate, as well as on the differential height to which the ray extends. Mr. Hunter confirms the accepted rule that refraction is least in the middle hours of the day, but he further regards its variations as seasonal, *i.e.* it is least in the springtime of the year.

But when all is said and done, it is the errors arising from the deflection of the plumb-line (not always ascertainable at the point of observation), and the possible variation in the actual height of the point observed (common enough in the case of snow-capped peaks), which chiefly affect the accuracy of angular determinations of altitude, and it is probably to these rather than to the unequal conditions affecting the

[1] "Formulæ for Atmospheric Refraction and their Application to Terrestrial Refraction and Geodesy." By J. de Graaff Hunter.

intermediate stratum of air that we must ascribe (*exempli gratia*) the doubt whether Kinchinjunga or K_2 is to hold the honourable position of second in altitude to Everest amongst the world's highest peaks. T. H. H.

REPORTS OF MUSEUMS.

THE report of the Bristol Museum for the year ending September 30, 1913, records praiseworthy activity, especially in the department of vertebrate zoology. Three plates show how attractively some of the more important specimens are displayed. A tiger shot by the King in Nepal, and presented by his Majesty, has been set up by Messrs. Rowland Ward, in a crouching attitude among bamboo stems, while the background, painted by Mr. Stanley Lloyd, shows the shooting-party approaching on elephants in the distance. Three springboks are placed near the margin of a veldt, on which other animals are browsing; this background was painted by Mr. G. E. Butler. The picturesque group in which pheasants are feeding (harmlessly) in the stubble, is backed by a view of Ashton Park, with the Clifton Suspension Bridge in the distance, composed by Mr. A. Wilde Parsons. This utilisation of really competent artists is an example to be followed. The geological department has not shared in the general progress, and considering the recent work of Vaughan and others in the west of England, this fact is rightly deplored by the committee.

With the aid of local naturalists, the small staff of the Hancock Museum at Newcastle-upon-Tyne has during the past two years accomplished some excellent work. From a 45-ft. Rorqual (*Balaenoptera borealis*) cast ashore near Amble, the complete skeleton, including ear-bones, hyoids, and rudimentary hip-bones, was obtained. The larger bones have been satisfactorily prepared in a sand-pit; but the smaller bones which were macerated as usual in water made so little progress that they have now been transferred to sand. A promising beginning was made with classes from the elementary schools, each of which went through a definite course of six lessons, given by the teachers, who were first rehearsed in the lesson by the curator, Mr. E. L. Gill. Unfortunately this regular system could not be followed in the second year, owing to the overcrowded curriculum of the schools, and the visits are now of small educational value. Perhaps the committee recently appointed by the British Association may devise some scheme that will overcome this difficulty.

The report of the Manchester Museum for the year 1912–13 bears witness to plenty of hard work, but contains nothing of outstanding interest. It is, however, worth reading in order that one may admire the healthy spirit of cooperation as regards museum matters that breathes in Manchester. Representatives of the University, of the City Council, and of subscribers among the outer public, constitute the committe of management. The City Council has increased its grant from 400*l.* to 800*l.* per annum. Professors of the University supervise and aid the museum staff. In the transference of the Egyptian antiquities to the new building, which, with its cases, was provided by Mr. Jesse Haworth, valuable help was given by a number of ladies and gentlemen. Several ladies have maintained a supply of fresh flowers, and at least four other names are mentioned in connection with solid pieces of work of more expert character. To a museum combining so many forces there naturally flow considerable donations, both in money and in kind.

RADIATION OF GAS MOLECULES EXCITED BY LIGHT.

THE first Guthrie lecture of the Physical Society was delivered on February 27, at the Imperial College of Science, South Kensington, by Prof. R. W. Wood, of Johns Hopkins University, Baltimore. The lecture has been established in memory of Prof. F. Guthrie, who was professor of physics in the Royal College of Science, and was founder of the society, the first meeting having been held in his lecture theatre at the college in 1874. Before Prof. Wood's lecture, Prof. G. Carey Foster gave a short biography of Guthrie, who was born in 1833 and died in 1886, and Sir Oliver Lodge recalled some personal reminiscences of him. Prof. Wood's lecture is summarised in the subjoined abstract, published by the Physical Society.

The emission and absorption of light by molecules and the allied phenomenon of dispersion have led us to the conception of something within the atom which is capable of responding to light waves in much the same way as a tuning-fork responds to sound waves of the same frequency as its own, and many mathematical treatments have been built up which explain more or less perfectly many of the phenomena in question. These still leave us very much in the dark as to what is going on. Helmholtz explained absorption by introducing a frictional term into his equations of motion for the atom, and though this led at once to an expression which represented anomalous dispersion, it left us ignorant of how the energy absorbed by the molecules was transformed to heat, or how the mean velocity of the molecules was increased by the excitation of vibrations within them. Planck avoided this difficulty by considering that the energy abstracted from the beam of light is re-emitted, though at the time the only experimental evidence was to be found in selective reflection, which occurs only in liquids and solids.

What becomes of the absorbed energy in the case of a gas? This was what he had been asking himself for many years. While he did not require a working model of the atom, he could not, however, be satisfied by an equation in which absorption was represented by a frictional term or selective reflection predicted by the occurrence of an imaginary quantity.

The problem of the constitution of the atom is one which must be approached from many sides, as it is improbable that any single mode of attack will reveal the secret. The spectroscope alone has proved itself powerless, one great difficulty being that in all known methods of exciting spectra one got "the whole or nothing."

Flames, arcs, sparks, and vacuum-tube discharges set a host of vibrations simultaneously in operation within the atom, and resulted in a complex of lines which were difficult to interpret.

His line of attack had been to maintain the molecules in as calm and tranquil a state as possible, by keeping them cool, and then to excite them to radiation by the application of an alternating electromagnetic field of a definite frequency—usually called monochromatic light. That this method has in some degree simplified matters was proved by the fact that sodium vapour could be made to emit only one of the D lines instead of the usual two.

The conditions necessary to stimulate radiation in this way varied considerably with the nature of the element studied. He would begin, however, with the simplest case, that of a vapour which exhibits a single absorption line and emits radiations similar in every respect to the exciting radiations when stimulated by light of frequency equal to that of the absorption line. This condition was perfectly fulfilled by the vapour of mercury, which has an absorption line at $\lambda=2536$ in the ultra-violet.

If a beam of monochromatic light of this wave-length was focussed at the centre of an exhausted quartz bulb containing a drop of mercury at atmospheric temperature, it was found that the light was powerfully scattered by the vapour, photographs of the bulb made with a quartz lens showing the cone of rays much as if the bulb were filled with smoke. The scattered light is invariably much more homogeneous than the incident beam, in which the "line" has a finite width, whereas the scattered light corresponds only with the centre of this line. The rest gets through the vapour unaffected. With the light thus scattered—the *resonance radiation*—a photograph was made of a quartz bulb containing a minute drop of mercury at room temperature. The bulb appeared as if filled with ink owing to the opacity of the vapour for the rays.

These phenomena, visible only to the camera, can be visually reproduced in the case of sodium vapour excited by the light from a sodium flame. If the density of the vapour is increased by warming it, the distance which the light can penetrate into the bulb is diminished and eventually the resonance radiation is all emitted from a region so close to the surface that it appears as a bright yellow patch on the inner surface of the glass.

If this patch is now used as a lamp, and focussed by a concave mirror on the surface of the same globe (or another in which the vapour is of sufficient density to give the patch effect) so as to fall partly on a surface whitened by deposited magnesia and partly on the enclosed vapour, the brightness of the two contiguous patches thus formed is practically equal.

This proves that, under those conditions, at comparatively low densities, *true absorption does not exist*, the light abstracted from the incident beam being re-emitted as light of the same wave-length but in all directions.

The factor of true absorption makes itself manifest as soon as we admit air or some other foreign gas. Even if the pressure is only a millimetre or two the effect is very marked.

Another point which can be brought out by this method of attack is whether or not the mechanisms the vibration frequencies of which correspond to the various lines in a spectrum are independent of each other or are interconnected.

An ingenious method was described whereby a beam of considerable intensity, consisting, however, of only D_1 or D_2 light, could be obtained, and if the sodium vapour excited by either of these was examined spectroscopically the emitted light contained only that one of the lines which was used to excite it. This shows that the D_1 and D_2 mechanisms are quite independent. In other cases, however, vapours excited by light of any one line of their spectrum gave out a resonance spectrum of that line and one or more others showing that some groups of mechanisms were interdependent and could not be excited separately.

Stimulation by Waves of Very Short Wave-Length.—Experiments were then described in which air, nitrogen, etc., had been caused to emit ultra-violet light when exposed to the action of radiation of wave-length less than the Schumann rays, the smallest waves hitherto known. Schumann rays were completely absorbed by quartz, but would pass through a considerable thickness of fluorite, but the rays to which he referred could be reduced in intensity by 98 per cent. by a plate of fluorite 1 mm. thick.

Nitrogen was more actively stimulated than air by these rays, as oxygen seemed to have a destructive effect on the phenomena. Thus iodine vapour, if mixed with nitrogen, emitted a green light under the action of the rays, while remaining dark if mixed with oxygen.

He urged the necessity of an exact mathematical treatment of the phenomenon of a molecule of vapour re-emitting radiation which it has abstracted from an incident beam, true absorption being absent.

At the conclusion of the lecture a number of interesting experiments illustrative of the subject of the lecture were shown. These included the resonance radiation of sodium stimulated by D light, of iodine vapour stimulated by the light from a quartz-mercury lamp, and of the author's method of extinguishing one of the D lines from the light from a sodium flame.

STRUCTURAL ANALOGIES BETWEEN IGNEOUS ROCKS AND METALS.

It was in Sheffield that the late Dr. H. C. Sorby lived and worked. It was to the Sheffield Literary and Philosophical Society that, in 1864, Sorby presented the first account of his microscopical examination of the structures of commercial steel. In Sheffield the worth of Sorby's work is now being recognised, and during the presidency of Mr. Arthur Balfour the Sheffield Society of Engineers and Metallurgists, an active and growing society closely associated with the industries of the city, has founded the "Sorby Lecture," to "mark its progress," and to perpetuate the memory of its late honorary member.

The first Sorby Lecture, on February 28, was the occasion for a large gathering of Sheffield's leading manufacturers and citizens at the Cutlers' Hall. The lecture was delivered by Prof. W. G. Fearnsides, the occupant of the Sorby chair of geology at Sheffield University, "On Some Structural Analogies between Igneous Rocks and Metals."

In the first part of the lecture Prof. Fearnsides traced the progressive development of the research by which Sorby, already trained to a knowledge of optics and of chemistry, learned from Williamson the art of making transparent sections of hard objects, and applied it (1849) to the study of rocks. Limestones were the first rocks to claim his attention (1851), then slates (1856), and then igneous rocks (1857), and from these, through meteorites (1862), he was led to study irons (1863–4). The difficulties which Sorby encountered and his patient toil, continued in defiance of indifference and ridicule, were discussed, and it was conjectured that the apathy with which his results were received was due to his own inability to appreciate the difficulties which his refined technique and the vector variations of the optical properties of minerals presented to other people.

The recognition of the value of Sorby's petrographic methods grew gradually through the sixties and seventies of last century, but it was not until after his announcement to the Iron and Steel Institute in 1886, that in the previous year a new microscope had enabled him to see the true composite nature of the "pearly constituent" of steel, that his pioneer work on metals attracted any attention.

It was by a fortunate but unforeseen coincidence that the first Sorby Lecture was delivered within a few days of the fiftieth anniversary of the day on which Sorby read the first of all papers dealing with the micro-structure of commercial metals, and the subject for the lecture was chosen accordingly.

The second part of the lecture dealt with the modern view that igneous rocks and metals are alike products derived by progressive partition of components during the crystallisation of mixed solutions. Being thus homologous in the manner of their origin, it was maintained that a mineralogical nomenclature which is properly applicable to the constituents of igneous rocks is similarly applicable to the constituents of steel; and though a phase rule (temperature-concentration) diagram affords a ready means for the discussion of the behaviour of phases during their partition into other pairs of phases, a metallographic description of their structure modelled on the nomenclature usual in petrography is more manageable when the number of constituents is large.

Special analogies between igneous rocks and metals were suggested. Segregation of the phosphorus and the sulphur in steel ingots was paralleled with "differentiation-*in-situ*" as it occurs in igneous rocks. The time taken in cooling through the temperature range of active crystal growth was shown to control the texture both of igneous rocks and of metals. Viscosity as another factor controlling crystal growth was considered, and the absence of any structures in metals analogous to those developed in viscous rock magmas and in devitrifying glass—*e.g.* "spherulitic structure"—was attributed to essential differences in this respect. "Skeletal crystals," so common in metals, are characteristic of over-rapid growth and as a passing stage in the development of polyhedra are not unknown in rocks.

"Eutectic structures" in metals are like the "graphic" and "pegmatitic" structures of rocks, and their obliteration with slower cooling, both from rocks and metals, was noted.

"Cores" in "mixed crystals" of metals are analogous to "zonary banding" in non-homogeneous isomorphous minerals, and the successive crystallisation of distinct phases above and below a change-point has its parallel in the "corona structure" of some norites.

Partition of solid solutions always at the margins or along the cleavage of pre-existing crystal grains, a process so important in the heat treatment of commercial steels, finds its analogue in the orderly separation of the "schiller constituents" within the minerals of plutonic rocks. "Perthitic structure" in slow-cooled felspars seems to require a similar explanation.

From analogies such as these it was argued that the experience of the geologist may be useful to the metallurgist, and that the knowledge of the structure of metals, which for commercial purposes are manufactured under controlled conditions of temperature and of stress, may provide a key of great adaptability with which, in conjunction with his map, his hammer, and his microscope, the geologist may decipher and interpret the autobiographical secrets of the record contained in the rocks

INDUSTRIAL RESEARCH IN AMERICA.[1]

GERMANY has long been recognised as pre-eminently the country of organised research. The spirit of research is there immanent throughout the entire social structure. This is not the time or place, however, nor is it necessary before this audience, to refer in any detail to the long record of splendid achievement made by German research during the last fifty years. It is inscribed in luminous letters around the rock upon which Germany now stands secure among the nations of the world.

The virility and range of German research were never greater than they are to-day. Never before have the superb energy and calculated audacity of German technical directors and German financiers transformed so quickly and so surely the triumphs of the laboratory into industrial conquests. Never has the future held richer promise of orderly and sustained progress, and yet the pre-eminence of Germany in industrial research is by no means indefinitely assured. A new competitor is even now girding up his loins and training for the race, and that competitor is, strangely enough, the United States—that prodigal among nations, still justly stigmatised as the most wasteful, careless, and improvident of them all.

To one at all familiar with the disdain of scientific teaching which has characterised our industry, and which still persists in many quarters, this statement is so contrary to the current estimate that its general acceptance cannot be expected. It will have served its purpose if it leads to a consideration of the facts which prove the thesis.

The country of Franklin, Morse, and Rumford, of McCormick, Howe, and Whitney, of Edison, Thomson, Westinghouse, and Bell, and of Wilbur and Orville Wright, is obviously a country not wholly hostile to industrial research or unable to apply it to good purpose. It is, however, not surprising that with vast areas of virgin soil of which a share might be had for the asking, with interminable stretches of stately forest, with coal and oil and gas, the ores of metals, and countless other gifts of nature scattered broadcast by her lavish hand, our people entered upon this rich inheritance with the spirit of the spendthrift, and gave little heed to refinements in methods of production and less to minimising waste. That day and generation are gone. To-day their children, partly through better recognition of potential values, but mainly by the pressure of a greatly increased population and the stress of competition between themselves and in the markets of the world, are rapidly acquiring the knowledge that efficiency of production is a sounder basis for prosperity than mere volume of product, however great.

The long-continued and highly organised research which resulted in the development of American agricultural machinery has led to the general introduction of machines which reduce the labour cost of seven crops 681,000,000 dollars, as measured by the methods of only fifty years ago.

You need not to be reminded that the ubiquitous telephone is wholly a product of American research. Munchausen's story of the frozen conversation which afterward thawed out is a clumsy fable. Think of the Niagaras of speech pouring silently through the New York telephone exchanges where they are sorted out, given a new direction, and delivered audibly perhaps a thousand miles away. New York has 450,000 instruments—twice the number of those in London. Los Angeles has a telephone to every four inhabitants. Why should one care to project one's astral body when he can call up from the club in fifteen seconds? Our whole social structure has been reorganised. We have been brought together in a single parlour for conversation and to conduct affairs, because the American Telephone and Telegraph Company spends annually for research, the results of which are all about us, a sum greater than the total income of many universities.

The name of Edison is a household word in every language. The Edison method is a synonym for specialised, intense research, which knows no rest until everything has been tried. Because of that method and the unique genius which directs its application, Italian operas are heard amid Alaskan snows and in the depths of African forests; every phase of life and movement of interest throughout the world is caught, registered, transported, and reproduced, that we may have lion hunts in our drawing-rooms and the coronation in a five-cent theatre. From his laboratory have come the incandescent lamp, multiple

[1] From the presidential address delivered before the American Chemical Society at Rochester, New York, September 9, 1913, by Arthur D. Little.

telegraphy, new methods of treating ores, and a thousand other diverse inventions, the development of a single one of which has sometimes involved millions.

Such development as that of the automobile industry in America has been based upon and vitalised by an immeasurable amount of research, the range and influence of which extend through many other industries. It has accelerated the application of heat treatment more than any other agency. One tyre manufacturer spends 100,000 dollars a year upon his laboratory. The research department organised by my associates for one automobile company comprised within its staff experts in automobile design, mathematics, metallography, and heat treatments, lubrication, gaseous fuels, steel and alloys, paints and painting practice, in addition to the chemists and physicists and assistants for routine or special work.

The beautiful city the hospitality of which has so greatly added to the pleasure and success of the present meeting of our society is the home of two highly scientific industries of which any community may well be proud. The Bausch and Lomb Optical Company, through its close affiliation with the world-famed Zeiss works at Jena, renders immediately available in this country the latest results of German optical research. The Eastman Kodak Company is perhaps more generally and widely known than even the Zeiss works, and in capital, organisation, value of product, and profit of operation will bear comparison with the great German companies whose business is applied science. Like them, it spends money with a lavish hand for the promotion of technical research and for the fundamental investigation of the scientific bases on which its industry rests. As you have happily been made aware, this work is carried on in the superb new research laboratories of the company with an equipment which is probably unrivalled anywhere for its special purposes. The laboratory exemplifies a notable feature of American industrial research laboratories in that it makes provision for developing new processes, first on the laboratory scale and then on the miniature factory scale.

To no chapter in the history of industrial research can Americans turn with greater pride than to the one which contains the epic of the electrochemical development at Niagara Falls. It starts with the wonderful story of aluminium. Discovered in Germany in 1828 by Wöhler, it cost 90 dollars a pound in 1855. In 1886 it had fallen to 12 dollars. The American Castner process brought the price in 1889 to 4 dollars. Even at this figure, it was obviously still a metal of luxury with few industrial applications. Simultaneously Hall in America and Heroult in Europe discovered that cryolite, a double fluoride of sodium and aluminium, fused readily at a moderate temperature, and, when so fused, dissolved alumina as boiling water dissolves sugar or salt, and to the extent of more than 25 per cent. By electrolysing the fused solution, aluminium is obtained.

On August 26, 1895, the Niagara works of the Pittsburgh Reduction Company started at Niagara Falls the manufacture of aluminium under the Hall patents. In 1911 the market price of the metal was 22 cents, and the total annual production 40,000,000 lb.

A chance remark by Dr. George F. Kunz in 1880 on the industrial value of abrasives turned the thoughts of Acheson to the problem of their artificial production, and led to the discovery in 1891 of carborundum and its subsequent manufacture on a small scale at Monongahela City, Pennsylvania. In 1894 Acheson laid before his directors a scheme for moving to Niagara Falls—to quote his own words :—

"To build a plant for 1000 horse-power, in view of the fact that we were selling only one-half of the output from a 134 horse-power plant, was a trifle too much for my conservative directors, and they one and all resigned. Fortunately, I was in control of the destiny of the Carborundum Company. I organised a new board, proceeded with my plans, and in the year 1904, the thirteenth from the date of the discovery, had a plant equipped with a 5000 electrical horse-power, and produced more than 7,000,000 lb. of those specks I had picked off the end of the electric light carbon in the spring of 1891."

The commercial development of carborundum had not proceeded far before Acheson brought out his process for the electric furnace production of artificial graphite and another great Niagara industry was founded. In quick succession came the Willson process for calcium carbide and the industrial applications of acetylene, phosphorus, ferro-alloys made in the electric furnace, metallic sodium, chlorine, and caustic soda, first by the Castner process, later by the extraordinarily efficient Townsend cell, electrolytic chlorates and alundum.

Perhaps even more significant than any of these great industrial successes was the Lovejoy and Bradley plant for the fixation of atmospheric nitrogen, which was perforce abandoned. It is well to recall, in view of that reputed failure, that the present-day processes for fixing nitrogen have made little, if any, improvement in yields of fixed nitrogen in a kilowatt hour over those obtained in this pioneer Niagara plant.

In the year 1800 a young assistant of Lavoisier, E. I. du Pont by name, emigrated to the United States, with others of his family, and settled on the banks of the Brandywine, near Wilmington, Delaware. He engaged in the manufacture of gunpowder. To-day the du Pont Company employs about 250 trained chemists. Its chemical department comprises three divisions : the field division for the study of problems which must be investigated outside the laboratory, and which maintains upon its staff experts for each manufacturing activity, together with a force of chemists at each plant for routine laboratory work; second, the experimental station, which comprises a group of laboratories for research work on the problems arising in connection with the manufacture of black and smokeless powder, and the investigation of problems or new processes originating outside the company; third, the Eastern Laboratory which confines itself to research concerned with high explosives. Its equipment is housed in seventy-six buildings, the majority being of considerable size, spread over fifty acres. Since no industrial research laboratory can be called successful which does not in due time pay its way, it is pleasant to record that the Eastern Laboratory is estimated to yield a profit to its company of 1,000,000 dollars a year. In addition to the generous salaries paid for the high-class service demanded by the company, conspicuous success in research is rewarded by bonus payments of stock.

The Gayley invention of the dry air blast in the manufacture of iron involves a saving to the American people of from 15,000,000 dollars to 29,000,000 dollars annually. A modern furnace consumes about 40,000 cubic feet of air a minute. Each grain of moisture in a cubic foot represents one gallon of water an hour for each 1000 cubic feet entering a minute. In the Pittsburgh district the moisture varies from 1·83 grains in February to 5·94 grains in June, and the water an hour entering a furnace varies accordingly from 73 to 237 gallons. In a month a furnace using natural air received 164,500 gallons of water, whereas with the dry blast it received only 25,524 gallons. A conservative statement, according to Prof. Chandler, is that the invention results in a 10 per cent. increase in output and a 10 per cent. saving in fuel.

Especially notable and picturesque among the triumphs of American industrial research is that by means of which Frasch gave to the United States potential control of the sulphur industry of the world. There is in Calcasieu Parish, Louisiana, a great deposit of sulphur 1000 ft. below the surface under a layer of quicksand 500 ft. in thickness. An Austrian company, a French company, and numerous American companies had tried in many ingenious ways to work this deposit, but had invariably failed. Misfortune and disaster to all connected with it had been the record of the deposit to the time when Frasch approached its problem in 1890. He conceived the idea of melting the sulphur in place by superheated water forced down a boring, and pumping the sulphur up through an inner tube. In his first trial he made use of twenty 150-h.p. boilers grouped around the well, and the titanic experiment was successful. The pumps are now discarded, and the sulphur brought to the surface by compressed air. A single well produces about 450 tons a day, and their combined capacity exceeds the sulphur consumption of the world.

An equally notable solution of a technical problem which had long baffled other investigators is the Frasch process for refining the crude, sulphur-bearing Canadian and Ohio oils. The essence of the invention consists in distilling the different products of the fractional distillation of the crude oil with metallic oxides, especially oxide of copper, by which the sulphur is completely removed, while the oils distill over as odourless and sweet as from the best Pennsylvania oil. The copper sulphide is roasted to regenerate the copper. The invention had immense pecuniary value. It sent the production of the Ohio fields to 90,000 barrels a day, and the price of crude Ohio oil from 14 cents a barrel to one dollar.

Turning from these examples of individual achievement so strongly characteristic of the genius of our people in one aspect, let us again consider for a moment that other and even more significant phase of our industrial research, namely, that which involves the coordinated and long-continued effort of many chemists along related lines.

Chemistry in America is essentially republican and pragmatic. Most of us believe that the doctrine science for science's sake is as meaningless and mischievous as that of art for art's sake or literature for literature's sake. These things were made for man, not for themselves, nor was man made for them. Most of us are beginning to realise that the major problems of applied chemistry are incomparably harder of solution than the problems of pure chemistry, and the attack, moreover, must often be carried to conclusion at close quarters under the stress and strain induced by time and money factors. In these circumstances it should not excite surprise that a constantly rising proportion of our best research is carried on in the laboratories of our great industrial corporations, and nowhere more effectively than in the research laboratory of the General Electric Company, under the guidance of your past president, Dr. Whitney.

Any attempt to present adequately the enormous volume of research work, much of which is of the highest grade, constantly in progress in the many scientific bureaus and special laboratories of the general government, or even to indicate its actual extent and range, is utterly beyond the limits of my attainments or of your patience. The generous policy of the Government toward research is unique in this, that the results are immediately made available to the whole people.

The United States is still essentially an agricultural country, and agriculture is, in its ultimate terms, applied photochemistry. The value of our farm property is already more than 42,000,000,000 dollars, and each sunrise sees an added increment of millions. Even small advances in agricultural practice bring enormous monetary returns.

Chief, therefore, among the government departments, in the volume of industrial research is the Department of Agriculture, which includes within its organisation ten great scientific bureaus, each inspired by an intense pragmatism and aggressively prosecuting research in its allotted field.

The research work of the Department of Agriculture is greatly augmented and given local application through the agency of sixty-four State agricultural experiment stations, established for the scientific investigation of problems relating to agriculture. These stations are supported in part by federal grants, as from the Hatch and Adams funds, and for the rest by State appropriations. Their present income exceeds 3,000,000 dollars. All are well equipped; one of them, California, includes within its plant a superb estate of 5400 acres, with buildings worth 1,000,000 dollars.

It may be said without fear of contradiction that through the combined efforts of the Department of Agriculture, the experiment stations, the agricultural colleges, and our manufacturers of agricultural machinery, there is devoted to American agriculture a far greater amount of scientific research and effort than is at the service of any other business in the world.

In the United States Patent Office Dr. Hall has developed a remarkably comprehensive index to chemical literature, which now contains 1,250,000 cards, and is open to every worker. The Bureau of Fisheries devotes 40,000 dollars to a single study, and the Geological Survey 100,000 dollars to the investigation of the mineral resources of Alaska.

The Bureau of Mines of the Department of the Interior was established to conduct on behalf of the public welfare fundamental inquiries and investigations into the mining, metallurgical, and mineral industries. Its appropriation for the current fiscal year is 662,000 dollars, of which 347,000 dollars is to be devoted to technical research pertinent to the mining industry.

Perhaps no better evidence could be adduced of the present range and volume of industrial research in America than the necessity, imposed upon the author of such a general survey as I am attempting, of condensing within a paragraph his reference to the Bureau of Standards of the Department of Commerce. Its purpose is the investigation and testing of standards and measuring instruments, and the determination of physical constants and the properties of materials. To these objects it devotes about 700,000 dollars a year to such good effect that in equipment and in the high quality and output of its work it has in ten years taken rank with the foremost scientific institutions in the world for the promotion of industrial research and the development and standardisation of the instruments, materials, and methods therein employed. Its influence upon American research and industry is already profound and rapidly extending.

I cannot better conclude this cursory and fragmentary reference to governmental work in applied science than with the words of the distinguished director of the Bureau of Standards:—

"If there is one thing above all others for which the activities of our Government during the past two or three decades will be marked, it is its original work along scientific lines, and I venture to state that this work is just in its infancy."

The present vitality and rate of progress in American industrial research is strikingly illustrated by its very recent development in special industries. It has been said that our best research is carried on in those laboratories which have one client, and that one themselves.

Twenty-five years ago the number of industrial concerns employing even a single chemist was very small, and even he was usually engaged almost wholly upon routine work. Many concerns engaged in business of a distinctly chemical nature had no chemist at all, and such a thing as industrial research in any proper sense scarcely came within the field of vision of our manufacturers. Many of them have not yet emerged from the penumbra of that eclipse, and our industrial foremen as a class are still within the deeper shadow. Meantime, however, research has firmly established itself among the foundation-stones of our industrial system, and the question is no longer what will become of the chemists. It is now what will become of the manufacturers without them.

In the United States to-day the microscope is in daily use in the examination of metals and alloys in more than 200 laboratories of large industrial concerns. An indeterminate but very great amount of segregated research is constantly carried forward in small laboratories, which are either an element in some industrial organisation or under individual control. An excellent example of the quality of work to be credited to the former is found in the development of cellulose acetate by Mork in the laboratory of the Chemical Products Company, while a classic instance of what may be accomplished by an aggressive individualism plus genius in research is familiar to most of you through the myriad and protean applications of Bakelite. The rapidity of the reduction to practice of Baekeland's research results is the more amazing when one considers that the distances to be travelled between the laboratory and the plant are often, in case of new processes and products, of almost astronomical dimensions.

Reference has already been made to the highly organised, munificently equipped, and splendidly manned laboratories of the Du Pont Company, the General Electric Company, and the Eastman Kodak Company. There are in the country at least fifty other notable laboratories engaged in industrial research in special industries. The expenditure of several of them is more than 300,000 dollars each a year. The United States Steel Corporation has not hesitated to spend that amount upon a single research, and the expenses of a dozen or more laboratories probably exceed 100,000 dollars annually. One of the finest iron research laboratories in the world is that of the American Rolling Mills Company.

The steel industry in its many ramifications promotes an immense amount of research, ranging from the most refined studies in metallography to experimentation upon the gigantic scale required for the development of the Gayley dry blast, the Whiting process for slag cement, or the South Chicago electric furnace. This furnace has probably operated upon a greater variety of products than any other electric furnace in the world. Regarding the steel for rails produced therein, it is gratifying to note that after two and one-half years or more no reports of breakage have been received from the 5600 tons of standard rails made from its output.

Industrial research is applied idealism. It expects rebuffs, it learns from every stumble, and turns the stumbling-block into a stepping-stone. It knows that it must pay its way. It contends that theory springs from practice. It trusts the scientific imagination, knowing it to be simply logic in flight. It believes with F. P. Fish, that "during the next generation—the next two generations—there is going to be a development in chemistry which will far surpass in its importance and value to the human race that of electricity in the last few years—a development which is going to revolutionise methods of manufacture, and more than that, is going to revolutionise methods of agriculture"; and it believes with Sir William Ramsay that "the country which is in advance in chemistry will also be foremost in wealth and general prosperity."

Modern progress can no longer depend upon accidental discoveries. Each advance in industrial science must be studied, organised, and fought like a military campaign. Or, to change the figure, in the early days of our science, chemists patrolled the shores of the great ocean of the unknown, and, seizing upon such fragments of truth as drifted in within their reach, turned them to the enrichment of the intellectual and material life of the community. Later they ventured timidly to launch the frail and often leaky canoe of hypothesis, and returned with richer treasures. To-day, confident and resourceful, as the result of many argosies, and having learned to read the stars, organised, equipped, they set sail boldly on a charted sea in staunch ships with tiering canvas bound for new El Dorados.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The City Council has renewed the annual grant to the University. An amendment by a Socialist member opposing the renewal, on the ground that the elementary education of the city and the technical school were being starved, was defeated by seventy votes to twenty-nine.

Dr. J. E. H. Sawyer has been appointed assistant to the chair of medicine.

Mr. H. A. Scarborough has been recommended to the Commissioners of the Exhibition of 1851 for a research scholarship.

Prof. Bostock Hill is to represent the University at the congress of the Royal Sanitary Institute in July next.

CAMBRIDGE.—The work submitted by Mr. T. W. Price, of Clare College, entitled "Osmotic Pressure of Alcoholic Solutions," has been approved by the Degree Committee of the Special Board for Physics and Chemistry as a record of original research.

OXFORD.—Under the existing constitution of the University, certain seats in the Hebdomadal Council are limited to the heads of colleges and professors respectively. A statute providing for the abolition of "orders" and for throwing the whole of the seats open to members of Convocation of five years' standing, which had been passed by small majorities in Congregation, was submitted in its final stage to Convocation on March 10. The proposed statute was supported by Prof. Geldart, and opposed by the rector of Exeter, and the warden of Wadham. It was rejected on a division by 97 to 83.

The preamble of a statute providing for the establishment of an additional professorship of chemistry, to be called "Dr. Lee's Professorship," passed Congregation without a division.

THE presentation of the portrait of Sir William Ramsay, K.C.B., to University College, London, and of the replica to Lady Ramsay, will be made on Wednesday next, March 18, at 4.30, in the Botanical Theatre.

THE appeal made by Girton College for 8000*l*. by January 1, 1914, to meet conditional promises of 12,000*l*. from an anonymous benefactor and 4000*l*. from Rosalind Lady Carlisle, has been completely successful, and the purpose of the appeal, which was the extinction of a mortgage debt of 24,000*l*., has now been achieved. The donation, we learn from the

Times, included 1000*l.* from the Drapers' Company and 500*l.* from the Clothworkers' Company.

THE presidency of Johns Hopkins University, Baltimore, which has been vacant since the resignation of Dr. Ira Remsen in 1912, has been filled by the appointment of Dr. Frank J. Goodnow, recently professor of administrative law at Columbia University, New York. In choosing an expert in this subject to succeed a chemist, Johns Hopkins has precisely followed the example of Harvard a few years ago, when Prof. A. Lawrence Lowell took the place of Dr. C. W. Eliot.

THE Local Lectures Summer Meeting will be held this year at the University of Cambridge on July 31–August 24. The new University examination halls and lecture-rooms will be used. The inaugural lecture will be delivered at 8 p.m. on July 31 by Sir J. J. Thomson. The lectures will be grouped round the general subject, "Some Aspects of Modern Life," and among the courses announced we notice one by Dr. L. Doncaster on heredity in animals and man. Forms of entry and further information about the meetings will be supplied by the Rev. Dr. Cranage, Syndicate Buildings, Cambridge.

LAST year Messrs. Harrods, Ltd., established a scheme of scholarships providing the holders with a year's training at their stores in commercial English, handwriting, arithmetic, French or Spanish, shorthand, typewriting, business routine, and salesmanship, with free meals. The scholarships are awarded on the nomination of shareholders; the nominees must be between the ages of fifteen and eighteen years, have had a fair education, and be able to pass a medical examination. They will secure a commercial education in which practice and theory will be combined; for the mornings are given to class instruction, and the afternoons to work in the departments, the holder of a scholarship being attached to a different department each month. This arrangement has worked admirably during the past year. Fifty scholarships will be available in September next, and the test examination for the nominees will be held in June or July. Messrs. Harrods' enterprise in establishing this system of training young people in the principles and practice of business-building is to be commended, and we believe it will achieve notable success.

AN article in the *Westminster Gazette* of March 3, by the Berlin correspondent of our contemporary, reveals a growing demand in Germany for more universities. It is alleged that existing universities are overcrowded owing chiefly to the invasion of foreign and of women students, and the more general need of university education for officials. The number of such institutions is smaller than it was a century ago. Cologne, Trier, Duisburg, Helmstedt, Wittenberg, Frankfurt-on-Oder, Mainz, Erfurt, Altdorf, and Ingolstadt have all been university towns. Since the empire was founded the number of students has increased fourfold. In 1880 there were 30,000 students; in 1905, 42,000; and last year more than 60,000. There are 5300 foreign and 3500 women students, and about 4000 non-student auditors. The agitation for new universities came to a head last year when Hamburg, Frankfurt-on-Main, Dresden, Posen, Cologne, and some smaller towns proposed to establish universities. The impulse in some cases was the desire of existing special and technical high schools to expand into universities with full university status, but with a reduced number of faculties. The advocates of new universities complain that the universities have recognised with ill-will the increasing specialisation of science; and that specialisation is now hopelessly ahead of them. Some reformers want not only specialisation within universities, but specialisation of the institutions themselves. Each university, while keeping its faculties and its general culture system, should aim at a predominant position in a particular branch of science; and should be specially well supplied with professorial chairs, seminaries, libraries, and collections bearing on its speciality.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 5.—Sir William Crookes, president, in the chair.—Harold **Wager**: The action of light on chlorophyll. When chlorophyll is decomposed by light, at least two distinct substances are formed, one of which is an aldehyde or mixture of aldehydes, and the other an active oxidising agent, capable of bringing about the liberation of iodine from potassium iodide. The decomposition of chlorophyll appears to be due directly to the action of light and is not an after effect of the photo-synthesis of carbon dioxide and water. It takes place only in the presence of oxygen, and it appears to be a case of photo-oxidation, for oxygen is used up so completely in the process that chlorophyll can be used instead of pyrogallol and caustic potash to determine the amount of oxygen in a given amount of air. In the absence of oxygen no bleaching takes place. Carbon dioxide is not necessary to the photo-decomposition of chlorophyll and is not used up in the process, even when present in considerable quantities.—C. H. **Warner**: Formaldehyde as an oxidation product of chlorophyll extracts.—Franklin **Kidd**: The controlling influence of carbon dioxide in the maturation, dormancy, and germination of seeds. Experiments are described showing that germination of seeds can be completely inhibited by carbon dioxide in the atmosphere (20–30 per cent., varying with the temperatures used). This inhibition is not accompanied by injury. The seeds germinate at once after removal from inhibitory CO_2 pressures. Experiments in the field showed that this action of CO_2 may actually occur in nature. If a quantity of green plant material is buried deep in the ground, seeds planted in the soil over this decaying material are inhibited in their germination by the CO_2 produced beneath them. This is of agricultural significance, and the fact that in the case of mustard seeds suspension of vitality continues, even after the external CO_2 has been removed, suggests an explanation of the common occurrence of dormant seeds of this plant in fields, and possibly of other natural cases of delayed germination.—J. **Hammond** and F. H. A. **Marshall**: The functional correlation between the ovaries, uterus, and mammary glands in the rabbit; with observations on the œstrous cycle.—Dr. J. F. **Gaskell**: The chromaffine system of annelids and the relation of this system to the contractile vascular system in the leech, *Hirudo medicinalis.* The possession of a chromaffine system, consisting of cells which take a yellow stain with chrome salts, is a common property of almost all members of the vertebrate kingdom. The presence of this reaction is coincident with the secretion of the pressor substance, adrenalin, and is probably dependent upon it. Even in the lowest vertebrate, Petromyzon, the system is well developed, being diffusely though segmentally arranged throughout the body. Chromaffine cells have also been observed in certain annelids by Sommet and Poll, reaching their highest development in the Hirudinea; the reaction is given by six nerve cells in each segmental ganglion. The conclusion is drawn that the contractile vascular system of vertebrates and its regulators, the chromaffine system and the sympathetic system, originally arose together in the annelid group.

Institution of Mining and Metallurgy, February 19.—Mr. Bedford McNeill, president, in the chair.—H. W. **Hutchin**: The assay of tin ores. The work recorded in this paper is the result of a prolonged use and study by the author of the well-known Beringer assay of tin ores, and the essential modification introduced consists in the use of lime as a diluent in place of zinc oxide, thus forming calcium stannate, which is more readily soluble in warm hydrochloric acid than is zinc stannate. Temperature influences the speed of the reaction, and the author's detailed experiments showed that the lime modification method was appreciably quicker than the zinc oxide method at "tin furnace" temperatures. Experiments made with diluents other than those already mentioned, as, for instance, barium carbonate and magnesia, showed the general superiority of lime, except in cases where only a small proportion of siliceous mineral is present, in which event zinc oxide shows a superiority to lime. The tests made were varied by differentiating between "tin furnace" and Bunsen burner temperatures, and the author's final opinion is in favour of a large Techlu burner used in conjunction with an asbestos boss, as giving the best conditions for ignition.—E. A. **Wraight** and P. Litherland **Teed**: The assay of tin ores and concentrates: the Pearce Low method. The authors have carried out an exhaustive series of tests with regard to the accuracy of this particular method of assaying tin, the results of which are embodied in their joint paper. As a result they arrived at the following conclusions. The degree of fineness of the ore must be at least 100 mesh, otherwise a representative sample cannot be obtained; nickel crucibles are superior to iron ones, and for tailings fusion in an iron crucible should be avoided; the amount of hydrochloric acid should be about 125 c.c.; the bulk of the solution before reduction should be about 400 c.c.; the temperature of the tin solution at titration should not be more than 70° F.; the strength of the standard solution should not generally be more than 11 grams of iodine and 20 grams of potassium iodide per litre, or less than one-third of that strength; before titration the calcite should have entirely dissolved; titanium, tungsten, and bismuth must be removed, and copper and iron should in special circumstances also be removed before titration; and nickel should always be used for reduction. With the observance of these precautions, the authors are of the opinion that the error should not exceed 2 lb. of black tin a ton with rich ores, and less with poor ores.—W. P. **Dreaper**: Formation of mineral deposits: precipitation and stratification in the absence of gels. This paper is a record of experiments made to determine whether the presence of gels is necessary to induce stratification, and for this purpose precipitation was conducted in capillary tubes, thereby avoiding certain disturbing influences. Under these conditions the author has been able to obtain stratification effects in the absence of secondary gels added to one of the reacting solutions. The substances experimented with comprised lead chloride, lead ferrocyanide, lead sulphate, barium sulphate, barium carbonate, and lead sulphide, and the results seem to show that stratification may be independent of the presence of gels.—T. R. **Archbold**: A device for filling ore sacks. This is a description of a simple device introduced in an out-of-the-way district for filling sacks with ore. A drum is divided into six compartments, and used in conjunction with a hopper, in such a manner that the revolutions of the drum serve to fill the compartments with a fixed amount of ore and deliver it into the sacks, six sacks being dealt with in each complete revolution.—E. O. **Marks**: A mining model. A description of a model constructed of iron, copper, and brass wire to show the direction and the extent of the workings of a mine. For convenience the block of ground is divided into unit sections of 1000 ft. cube, reduced in the model to a scale of 100 ft. to the inch, and the skeleton cubes representing these units are successively fitted with brass and copper wires showing the direction and length of shafts, levels, crosscuts, etc. The advantage of a model of this type, apart from its graphic character, lies in the ease of extension as the mine undergoes development.

Zoological Society, March 3.—Prof. E. W. MacBride, vice-president, in the chair.—C. Tate **Regan**: Freshwater fishes from Dutch New Guinea collected by the British Ornithologists' Union and Wollaston Expeditions. *Symbranchus bengalensis* was obtained for the first time in New Guinea. The collections included examples of two species of Melanotæniine Atherinids.—H. Wallis **Kew**: The nests of Pseudoscorpiones: with historical notes on the spinning-organs and observations on the building and spinning of the nests. The paper described the nests in which these animals enclose themselves for moulting, for brood purposes, and in some cases for hibernation. They are closed cells of spun tissue, with or without a covering of earthy or vegetable matters. The tissue is of innumerable threads crossed and coalesced irregularly, without interspaces, and almost like silk-paper. With regard to the spinning-apparatus, confusion has existed; but the author's observations on living animals place it beyond doubt that the cephalothoracic glands are the organs concerned. Contrary to previous statements, the "combs" of the cheliceræ have nothing to do with the silk. The manner in which the nests are built and spun was described in detail.—H. R. **Hogg**: A collection of spiders. The collection was made by Mr. P. D. Montague, supplemented by a few specimens sent by Mr. T. H. Haynes from the Montebello Islands off Onslow, on the north-west coast of Australia. These islands, from geological evidence, were part of the old coast-lines, though now about ninety miles away. Although the larger specimens are mostly widely spread and possibly more or less recent importations, the smaller are nearly all new species, showing evidence of a much longer separation from their congeneric relations on the mainland. Out of seventeen species ten are new, as well as a new genus and two new varieties.—D. M. S. **Watson**: The skull of a Pariasaurian reptile and the relationships of that type. The skull of Pariasaurus is completely described, with the exception of the bony labyrinth of the ear. It is compared with all the members of the order Cotylosauria, which are well enough known to make a comparison of any value, and shown to differ in the very important characters of the brain-case from all of them, representing an entirely distinct branch.—F. J. **Meggitt**: A tapeworm parasitic in the stickleback (*Gasterosteus aculeatus*).—Dr. W. **Nicoll**: Trematode parasites obtained from animals that died in the society's gardens during 1911–12.

Paris.

Academy of Sciences, March 2.—M. P. Appell in the chair.—F. **Wallerant**: The polymorphism of camphor. Crystals of camphor deposited at the ordinary temperature from an alcoholic solution are rhombohedral. Fused camphor may take three crystalline forms, so that camphor is at least quadrimorphous.—C. **Moureu** and A. **Lepape**: The helium from fire-damp and the radio-activity of coal. Fire-damp from Anzin has been previously shown by the authors to contain 0·04 per cent. of helium, and as the amount of crude gas evolved a day is estimated at 30,000 cubic metres, this corresponds to 12 cubic metres of helium a day. The amounts of radium and thorium in the ash of the coal have been determined, in this and other coals yielding fire-damp containing helium, and do not correspond to such large proportions of helium. The larger part of the gas is not derived from the radio-active material of the coal, and must be regarded as fossil helium.—André **Blondel**: The effect and production of the higher harmonics in the transport of electrical energy at high potentials.—P. **Sabatier** and A. **Mailhe**: The ester oxides of carvacrol. A study of the direct dehydration of carvacrol by the action of thorium oxide upon the vapour at temperatures between 400° and 500° C.—M. **Gambier**: Algebraic curves of constant torsion, real and not unicursal.—F. **Jager**: The application of the method of Fredholm to the tides of a basin limited by vertical walls.—E. **Mazurkiewicz** and W. **Sierpinski**: An ensemble superposable with each of its two parts.—A. **Pchéborski**: A generalisation of a problem of Tchébischeff and of Zolotareff.—C. **Gutton**: The specific inductive capacity of liquids. According to Voigt's hypothesis, the force which acts on an electron deviated from its equilibrium position in an electric field should not be exactly proportional to the deviation, and hence the specific inductive capacity ought to depend on the intensity of the field. In measurements made with toluene the deviations observed in the specific inductive capacity were of the same order as the experimental error. A slight diminution with increase of field was noticed with bromonapththalene, 4·72 to 4·69.—Maurice **de Broglie**: The spectra of the Röntgen rays. Rays emitted by antikathodes of copper, iron and gold.—J. de **Kowalski**: An explosive luminous phenomenon in rarefied nitrogen. The author confirms the observations of Strutt that nitrogen free from the smallest trace of oxygen is transformed into active nitrogen in a discharge in electrodeless tubes. A curious explosive phenomenon is described which is attributed to a temporary combination between the active nitrogen and traces of mercury vapour unavoidably present to form mercury nitride, the latter decomposing spontaneously.—H. **Labrouste**: A molecular transformation of thin layers on water.—F. **Baud**, F. **Ducelliez**, and L. **Gay**: A calorimetric study of the system water-monomethylamine.—H. **Gault**: A new method of preparation of tricarballylic acid. Oxalocitric lactone cannot be distilled under reduced pressure without decomposition. The liquid obtained by distillation is not, as was supposed by Wislicenus and Beckh, the unchanged lactone, but proves to be ethyl $\alpha\alpha\beta\gamma$-propane-tetracarboxylate. With dilute mineral acids a quantitative yield of crystalline tricarballylic acid is obtained.—Enrique **Hauser**: A new method for the detection and determination of gaseous hydrocarbons dissolved in mineral waters. After adding potash to the water it is shaken with air and the latter analysed.—M. **Piettre** and A. **Vila**: Observations on fibrinogen and the oxalated plasma.—W. **Kopaczewski**: The influence of acids on the activity of dialysed maltase. The observed effects cannot be explained exclusively by the concentration of the acid ions.—Mlle. Jeanne **Weill**: The amount of fatty acids and cholesterol in the tissues of cold-blooded animals.—Paul **Fallot**: The tectonic of the sierra of Majorca.—Emile **Belot**: An attempt at a physical theory of the formation of the oceans and primitive continents.—F. **Malméjac**: The importance of the estimation of chlorides for the control and evaluation of drinking water.—A. **Boutaric**: The thermal state of the atmosphere.

BOOKS RECEIVED.

Om Forandringer i Ringkobing Fjords Fauna. By A. C. Johansen. Pp. 144. (Kobenhavn: Bianco Lunos Bogtrykkeri.)

Wissenschaftliche Ergebnisse der Deutschen Zentral-Afrika-Expedition, 1907–8. Band v. Zoologie iii. Lief. 1. Orthoptera. By J. A. G. Rehn. Pp. 223. (Leipzig: Klinkhardt und Biermann.) 8.40 marks.

Albin Haller. Biographie, Bibliographie Analytique des Écrits. By E. Lebon. Pp. 120. (Paris: Gauthier-Villars; Masson et Cie.) 7 francs

Cours de Physique. By Prof. E. Rothe. Première Partie. Généralités — Unites — Similitude—Mesures. Pp. vi+183. (Paris: Gauthier-Villars.) 6.50 francs.

Theorie Mathematique de l'Echelle Musicale. By A. Vaucher. Pp. 68. (Paris: Gauthier-Villars.) 2.25 Francs.

The Fleet Annual and Naval Year Book, 1914. Compiled by L. Yexley. Pp. 135. (London: The Fleet, Ltd.) 1*s.* net.

Progress of Education in India, 1907–12. By H. Sharp. Vol. i. Pp. xvii+284+xxxii. (Calcutta: Superintendent Government Printing, India.) 6*s.*

The Pigments and Mediums of the Old Masters. By Prof. A. P. Laurie. Pp. xiv+192+xxxiv plates. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Intermetallic Compounds. By Dr. C. H. Desch. Pp. vi+116. (London: Longmans and Co.) 3*s.* net.

Die Theorie der Strahlung und der Quanten. Edited by A. Eucken. Pp. xii+405. (Halle a. S.: W. Knapp.) 15.60 marks.

Industrial Chemistry for Engineering Students. By Prof. H. K. Benson. Pp. xiv+431. (London: Macmillan and Co., Ltd.) 8*s.* net.

The Mineral Resources of the Philippine Islands for the Year 1912. Pp. 76+vii plates. (Manila: Bureau of Science.)

Careers for University Men. By H. A. Roberts. Pp. 22. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.) 6*d.* net.

The Principles of War Historically Illustrated. By Major-General E. A. Altham. Vol. i. Pp. xv+436, and 5 maps to illustrate the volume. (London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

Anthropology as a Practical Science. By Sir R. C. Temple. Pp. 96. (London: G. Bell and Sons, Ltd.) 1*s.* net.

Die Stoffwanderung in ablehenden Blattern. By Dr. N. Swart. Pp. 118+v plates. (Jena: G. Fischer.) 6 marks.

Kristallberechnung und Kristallzeichnung. By Dr. B Gossner. Pp. vi+128 (Leipzig und Berlin: W. Engelmann.) 8 marks.

Muscular Work. By F. G. Benedict and E. P. Cathcart. Pp. vi+176. (Washington: Carnegie Institution.)

Piebald Rats and Selection. By W. E. Castle and J. C. Phillips. Pp. 54+3 plates. (Washington: Carnegie Institution.)

Carnegie Institution of Washington. Year Book. No. 12, 1913. Pp. xvi+336. (Washington: Carnegie Institution.)

DIARY OF SOCIETIES.

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—Note on a Functional Equation Employed by Sir George Stokes: Sir James Stirling.—The Mercury Green Line $\lambda = 5461$ as Resolved by Glass and Quartz Lummer Plates and on its Zeeman Components: Prof. J. C. McLellan and A. R. McLeod.—The Electrical Condition of a Gold Surface During the Absorption of Gases and their Catalytic Combustion: H. Hartley.—The Diffusion of Electrons through a Slit: J. H. Mackie.—The Rate of Solution of Hydrogen by Palladium: Dr. A. Holt.—The Dispersion of a Light Pulse by a Prism: Dr. R. A. Houston.

ROYAL INSTITUTION, at 3.—Heat and Cold: Prof. C. F. Jenkin.

CONCRETE INSTITUTE, at 7.30.—Forms for Concrete Work: A. Graham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Design of Rolling Stock for Electric Railways: H. E. O'Brien.

FRIDAY, MARCH 13.

ROYAL INSTITUTION, at 9.—An Indian State: Sir Walter R. Lawrence, Bart.

MALACOLOGICAL SOCIETY, at 8.—Diagnosis of Four New Land Shells from German New Guinea: C. R. Boettger.—Characters of Three New Species of Ennea from Southern Nigeria: H. B. Preston.—A Synopsis of the Family of Veneridæ. II.: A. J. Jukes-Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Correction of Errors in the New Lunar Theory; (2) The Terms in the Moon's Motion Depending on the Node; (3) The Perigee and Eccentricity of the Moon, 1750—1901; (4) The Determination of the Node, the Inclination, the Earth's Ellipticity, and the Obliquity of the Ecliptic, from Greenwich Meridian Observations of the Moon, 1847—1901: E. W. Brown.—Baxendell's Observations of Variable Stars: R. Bootis, R. Cancri, R. Coronæ, S. Coronæ, H. H. Turner, and Mary A. Blagg.—Micrometrical Measures of Double Stars in 1913: Rev. T. E. R. Phillips and H. F. Acocks.—The Spectra of Hydrogen and Helium: J. W. Nicholson.—The Total Light of the Stars: S. Chapman.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Lightning Conductors and their Tests: F. H. Taylor.

ALCHEMICAL SOCIETY, at 8.15.—Roger Bacon: R. Rowbottom.

PHYSICAL SOCIETY, at 8.—Time Measurements of Magnetic Disturbances and their Interpretation: Dr. C. Chree.—The Ratio of the Specific Heat of Air, Hydrogen, Carbon Dioxide and Nitrous Oxide: H. N. Mercer.—The Asymmetric Distribution of the Secondary Electronic Radiation produced by X-Radiation: A. J. Philpot.—A Lecture Experiment on the Irrationality of Dispersion: Prof. S. P. Thompson.

SATURDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

MONDAY, MARCH 16.

ROYAL SOCIETY OF ARTS, at 8.—Surface Combustion. I: Prof. W. A. Bone.

TUESDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—Modern Ships. The War Navy: Sir John H. Biles.

ROYAL STATISTICAL SOCIETY, at 5.—The Sizes of Businesses, Mainly in the Textile Industries: Prof. S. J. Chapman, and T. S. Ashton.

ZOOLOGICAL SOCIETY, at 8.30.—(1) The Annelids of the Family Nereidæ collected by Mr. F. A. Potts in the N.E. Pacific in 1911, with a Note on Micronereis as a Representative of the Ancestral Type of the Nereidæ; (2) The Genera Ceratocephale Malmgren and Tylorrhynchus, Grube: L. N. G. Ramsay.—The Structure and Development of the Caudal Skeleton of the Teleostean Fish, *Pleuragramma antarcticus*: A. K. Totton.—Report on the Mollusca collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: G. C. Robson.—The Mechanism of Suction in the Potato Capsid Bug (*Lygus pabulinus*, Linn.); P. R. Awati.—Coleoptera Heteromera collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: K. G. Blair.—The Malay Race of the Indian Elephant: R. Lydekker.—Fauna of Western Australia. I. The Onychophora of W. Australia. II. The Phyllopoda of W. Australia: Prof. W. J. Dakin.

INSTITUTE OF METALS, at 8.—Annual General Meeting.—President's Inaugural Address: Sir Henry J. Oram.

ILLUMINATING ENGINEERING SOCIETY, at 8.—A Comparison between Illumination Estimates and Performance in Practice: W. C. Clinton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Concluding Discussion:* Rail steels for Electric Railways: W. Willox.—Rail-corrugation and its Causes: S. P. W. D'Alte Sellon.—*Papers:* Some Recent Developments in Commercial Motor-vehicles: T. Clarkson.—Comparative Economics of Tramways and Railless Electric Traction: T. G. Gribble.

MINERALOGICAL SOCIETY, at 5.30.—An Occurrence of Bornite Nodules in Shale from Mashonaland: F. P. Mennell.—Augite from Bail Hill, Dumfriesshire: A. Scott.—(1) A Sulpharsenite of Lead from the Binnenthal; (2) Gmelinite and Chabazite from Co. Antrim: Dr. G. T. Prior.

WEDNESDAY, MARCH 18.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Climate as Tested by Fossil Plants: Prof. A. C. Seward.

AERONAUTICAL SOCIETY, at 8.30.—Lessons Accidents have Taught: Col. H. C. Holden.

ROYAL SOCIETY OF ARTS, at 8.—House Flies and Disease: E. H. Ross.

INSTITUTE OF METALS, at 10.30 a.m.—First Report to the Beilby Research Committee, dealing with the Solidification of Metals from the Liquid State: Dr. C. H. Desch.—Bronze: J. Dewrance.—Vanadium in Brass: The Effect of Vanadium on the Constitution of Brass containing 50—60 per cent. of Copper: R. J. Dunn and O. F. Hudson.—The Quantitative Effect of Rapid Cooling on Binary Alloys. II: G. H. Gulliver.—Crystal Protomorphs and Amorphous Metal: Prof. A. K. Huntington.—First Report of the Nomenclature Committee.—The Influence of Nickel on Some Copper-Aluminium Alloys: Prof. A. A. Read and R. H. Greaves.—Muntz Metal: The Correlation of Composition, Structure, Heat Treatment, and Mechanical Properties, etc.: Dr. J. E. Stead and H. G. A. Stedman.—The Micro-Chemistry of Corrosion. II: S. Whyte and Dr. C. H. Desch.

ENTOMOLOGICAL SOCIETY, at 8.—(1) A Contribution to the Life-History of *Agriades thersites*; (2) A New Form of Seasonal (and Heterogoneutic) Dimorphism: Dr. T. A. Chapman.

THURSDAY, MARCH 19.

ROYAL SOCIETY, at 4.30.—*Discussion:* Constitution of the Atom. Opener: Sir E. Rutherford.

ROYAL INSTITUTION, at 3.—Heat and Cold: Prof. C. F. Jenkin.

CHILD STUDY SOCIETY, at 7.30.—The Dramatic Impulse in Children: Prof. J. J. Findlay.

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INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Electric Battery Vehicles.

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INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Chemical and Mechanical Relations of Iron, Tungsten and Carbon, and of Iron, Nickel, and Carbon: Prof. J. O. Arnold and Prof. A. A. Read.

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THURSDAY, MARCH 19, 1914.

AN ELIZABETHAN COOKERY-BOOK.

A Proper Newe Booke of Cokerye. Edited by Catherine F. Frere. Pp. clxiv+124. (Cambridge: Heffer and Sons, Ltd., 1913.) Price 7*s.* 6*d.* net.

WHETHER cookery-books should rank as literature is a question upon which opinions may well differ. Charles Lamb, we fear, would have stigmatised the majority of them as among the books which are no books. But whatever exceptions he might have been induced to make, one of them would certainly have been Miss Frere's work. And this because of his reverence for things ancient and of good repute. It would have quickened his instincts as a bibliograph, and he would have chuckled over the evidence of the playful imagination, delicate wit, and subtle humour with which the editor has embellished the setting of her antique and historic jewel. He would have appreciated, too, the element of comedy in the fact that although Miss Frere, as she frankly confesses, has never had the opportunity of acquiring the art of cookery, she should yet have been fated to edit no fewer than four books on the subject.

The origin of the present work may be told in a few words. The good and learned Matthew Parker, Archbishop of Canterbury from 1559 to 1575, and a former Master of Corpus Christi College, Cambridge, from which he had been ejected during Queen Mary's reign, presented a great collection of valuable manuscripts, as well as many printed books, to his old College and to the University Library, concerning which Dr. Berne, the then Vice-Chancellor, wrote of "the singular beauty that the comely order of Your Grace's books doth bring to the University Library, to the great delectation of the Eye of Every man that Shall Enter into the Said Library." Among the printed books given to the College is a little volume bound in vellum, in which, wedged in between political and learned tracts, is a black-letter octavo of twenty-seven pages, entitled "A Proper Newe Booke of Cokerye." This, with the approval of the Master and Fellows, Miss Frere has caused to be reprinted, furnishing it with an admirable introduction, many excellent annotations, and a useful glossary-index.

The original Cambridge edition is dateless, but was probably published during Parker's tenure of the See of Canterbury. According to Hazlitt, the book was often reprinted before 1546, and was, in fact, a recension of the "Book of Cookery" of 1500, of which there was a reprint by John Byddell about 1530. This was often reproduced, with modifications, and under various names, down to 1650, much of it being embodied in the household books of those days, as, for example, in Thomas Dawson's "Good Huswife's Jewell," of 1596.

Of the original author nothing is known, not even his, or her, name; but one may surmise that the compilation was in all probability the work of a monk, to whom the occupation, we may take it, would not be uncongenial. Authoresses, especially of works on cookery, were not plentiful in those days. Even the classical work of Mrs. Glasse, a book of a much later date, was, according to Boswell, written by a mere man, Dr. Hill.

As we turn over the leaves of the "Proper Newe Booke," with its quaint recipes, couched in the "corrupted phonetic" of the golden age of English prose, we gather, as our author says, "a little rushlight illumination on the culinary mysteries of the once busy kitchens, roofless and empty to-day, and on the hospitalities, feasting, and revels of the now silent dining halls of long ago."

Matthew Parker was a large-minded man, who, living in spacious times, did things in a spacious way. Although an abstemious man himself, and not overburdened with the temporalities of his see, he exercised an almost boundless hospitality, both at Canterbury and at Lambeth, and we can well imagine that Mistress Margaret Harlestone, his devoted wife, who, "for her husband's credit," says Strype, "had all things handsome about her—ordering her housekeeping so nobly and splendidly that all things answered that venerable dignity," must have been sorely exercised at times "to avoid the shame of her Lord's table," especially when, as occasionally happened, his Royal Mistress, in one of her many Progresses, intimated her intention of dining with him, together with the whole of her Privy Council. We fancy at such a time there must have been much searching through the scanty pages of the "Proper Newe Booke."

But to the general reader of to-day, perhaps, the most enlightening, as well as the most interesting portion of Miss Frere's book is her introduction, in which she conjures up a vivid picture of "the gay company that rejoiced and feasted, the fighters and revellers, the grave statesmen, prelates, and lawyers, the admirals, bold sea captains, knights, and ladies, the great lords and princes" that revolved, as about a sun, around their imperious Queen, every inch a Tudor, who combined all the strength of will and masterfulness of her father, with, at times, some of the womanly traits of her luckless mother. Very sympathetic, too, is the word-picture Miss Frere draws of the great archbishop—of his courage, his loyalty, his devotion to duty, his broad catholicism, his steadfastness, integrity, and liberality. It needed such a man to steer the reformed Church through those troubled times, when practically every ruler in Europe was conspiring with a disloyal faction at home to bring England once more under the heel of the Papacy.

But if Miss Frere has an eye for the picturesque, she has also a pretty wit, and enlivens her narrative from time to time with frequent sallies of humour and many a good story. We shall not anticipate the reader's pleasure by repeating these, strong as is the temptation. It must suffice here to say that Miss Frere, by her book, has added to the gaiety of gourmets, if not of nations. M. D. W.

APPLIED ELECTRICITY.

(1) *A Primer on Alternating Currents.* By Dr. W. G. Rhodes. Pp. viii+145. (London: Longmans, Green and Co., 1912.) Price 2*s*. 6*d*. net.

(2) *Single-Phase Commutator Motors.* By F. Creedy. Pp. x+113. (London: Constable and Co., Ltd., 1913.) Price 7*s*. 6*d*. net.

(3) *The Development of the Incandescent Electric Lamp.* By G. Basil Barham. Pp. viii+198. (London: Scott, Greenwood and Son, 1912.) Price 5*s*. net.

(4) *Allgemeine Elektrotechnik. Hochschul-Vorlesungen.* By Prof. P. Janet. Autorisierte Deutsche Bearbeitung von F. Suchting and E. Riecke. Erster Band. Grundlagen Gleichstrome. Bearbeitet von F. Suchting. Pp. vi+269. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 6 marks.

(1) DR. RHODES' book can scarcely be recommended to those students of limited mathematical knowledge for whom it is avowedly written. Throughout, the author seems to employ trigonometrical functions whenever he can get an excuse for doing so, while in many cases he omits vector diagrams which would probably be of more assistance. The book is open to the criticism of being too academic and out of touch with real things. For instance, we might mention the calculation of iron losses from formulæ instead of reading them off directly from the experimental curves; the "design" of a transformer by assuming a certain flux density and then putting in enough iron to get a specified iron loss without any regard as to whether that iron is required or not; the elaboration of formulæ for the efficiency of synchronous machines taking account only of the copper loss; and, finally, the combination of the fluxes produced by the different coils of a polyphase motor by adding them algebraically, after rectification for some obscure reason, instead of taking account of their directions in the usual manner. The reader's confidence in the remainder of the book is scarcely restored by the hazy "due to the influence of the rotor currents," which is advanced as an explanation of the discrepancy between the known facts and the results of this curious proceeding.

(2) Mr. Creedy writes on a subject which he has made his own, and he introduces us to some new and fertile ideas in connection with it. His book requires a very close study to master it, and we cannot but feel that the reader's path would have been much easier if the author had given a *continuous* exposition of his method as applied to a single type of machine, instead of explaining it in snippets with other matter between.

So far as fluxes are concerned, he makes his case fairly clear, but when he applies his ellipses to E.M.F.'s he is less convincing. He employs space diagrams to combine E.M.F.'s in series, for which only time-phase matters, and although the latter does depend on the instantaneous position of the coil, his description brings forward no reason why his construction should give the correct result. The statement as to the equality, at synchronous speeds, of the transformer and motion E.M.F.'s in two mutually perpendicular axes should be proved, particularly as the student will have some difficulty in imagining a winding which will give a constant harmonic distribution about a fixed axis while it itself rotates.

Here and there the book is marred by the use of loose expressions which make a difficult subject still more difficult. Thus, we have "rotating ellipse" to describe a curve which is fixed but the radius of which is supposed to rotate. A greater attention to the agreement between the lettering of the diagrams and the text, and to the suitable juxtaposition of corresponding connection and vector diagrams would have been a help to the reader.

In spite of these little defects, we are strongly of the opinion that this book should be on the shelves of all who are interested in the subject.

(3) The account of the early incandescent lamps and of the carbon and tantalum filaments which Mr. Barham gives will be read with much interest by many outside electrical circles. If only the remainder of the book had been similar, we should have had little but praise for it. But the second half of the book, dealing mostly with tungsten lamps, lacks perspective, and wearies the reader. Even the author seems to feel, in one place, that

the matter is too much an echo of the claims and hopes of the various inventors, as recorded in their patent specifications, and too little an account of processes in actual use in the factories which turn out tungsten filaments on a commercial scale. In fact, very few even of those readers who wade through the whole ninety or so pages about these lamps will have gained the faintest idea of these processes. A reduction of this portion of the book would have given space for a description of the Nernst lamp and its properties, which lamp certainly deserves more than a casual mention.

(4) The last of the books before us can be recommended to those who would prefer to read the matter in German. The ground taken up is, for the most part, thoroughly discussed from the theoretical point of view, and the British reader will probably come across some instructive ideas which are new to him. In places there is a tendency to ignore facts which do not lend themselves to a simple theory, and there is a leaning to the physical side of the subject rather than to the engineering side. There are also some statements which give the reader quite a wrong impression, because they are not accompanied by a statement of the very special conditions to which they apply. For instance, we are told that the E.M.F. of a ring armature is independent of the number of poles, while the power is proportional to that number, in such a way that the reader would take the statement to apply to a given armature, whereas it would only apply if the size of the armature were increased along with the number of poles so that each of the latter might be kept of a constant size. The book does not contain, as a knowledge of English books with equivalent titles might lead one to expect, any structural details or views of machines. Still, it is well worth reading, and certainly merits a more substantial binding than the publisher has given it.

D. R.

SCIENCE AND PHILOSOPHY.

(1) *Proceedings of the Aristotelian Society.* New Series. Vol. xiii. Pp. 375. (London: Williams and Norgate, 1913.) Price 10*s.* 6*d.* net.

(2) *Encyclopædia of the Philosophical Sciences.* Vol. i.: Logic. By A. Ruge, W. Windelband, J. Royce, and others. Translated by B. Ethel Meyer. Pp. x+269. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(3) *Evolution by Cooperation.* A Study in Bio-Economics. By H. Reinheimer. Pp. xiv+200. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1913.) Price 3*s.* 6*d.* net.

(4) *The Science of the Sciences.* By H. Jamyn Brooks. Pp. 312+ix. (London: David Nutt, n.d.) Price 3*s.* 6*d.* net.

(5) *Probleme der Entwicklung des Geistes.* Die Geistesformen. By S. Meyer. Pp. v+429. Leipzig: J. A. Barth, 1913.) Price 13 marks.

(6) *Naturphilosophische Plaudereien.* By H. Potonié. Pp. v+194. (Jena: Gustav Fischer, 1913.) Price 2 marks.

PLATO dreamed of a dialectic that should be the science of the sciences, and philosophers have often assumed that philosophy is the essence of knowledge, into which are distilled the results of empirical research. Metaphysical logic may be considered to assist science by suggesting new modes of generalisation, new points of view for classified facts. Darwin's theory of natural selection was a philosophical view; so is Bergson's estimate of mind. Every *-ism* is of this nature; Weismannism and Mendelism, neo-Darwinism and Pragmatism, are examples. Mathematics is equally suggestive of new generalisations; the work of Galton and of Karl Pearson are cases in point. The $\Phi\iota$ formula of Mr. William Schooling is perhaps the most recent. But it is arguable that all such generalisations are ultimately themselves suggested by new facts, and simply show the mind's plasticity of reaction to new environments. It is arguable that they are inevitable and obvious, once given the particular concatenation of facts suggesting them, but that the discovery of new concatenations of facts is not at all beholden to philosophical suggestion. It is said that the inductive idea suggested to Bacon a new mode of research; on the contrary, it was the increase in observed facts and new concatenations of facts that suggested the inductive idea.

The study of forms of thought develops with the material for thought, witness the developments introduced by Poincaré and Bertrand Russell. The latter's analysis, in (1) "The Proceedings of the Aristotelian Society," of the notion of cause is a refreshing proof of philosophical vitality. The word "cause," he says, "is so inextricably bound up with misleading associations as to make its complete extrusion from the philosophical vocabulary desirable." He well points out that advanced sciences like gravitational astronomy, even physics in general, never employ the term "cause." "The reason why physics has ceased to look for causes is that, in fact, there are no such things. The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm." What scientific laws do, instead of stating that one event A is always followed by another event B, is to state *functional relations* between certain events at certain times (these are *determinants*), and other events at earlier or later times, or at the same time. No *a priori* category at all is involved.

One of the most elementary philosophical ideas is that of purpose in evolution. Another is evolution. Mr. Arthur Lynch criticises the latter (papers of the Aristotelian Society) in an interesting and anecdotic essay. Very much in point is one of his texts, viz., the remark of Kirchhoff: "There is only one science (mechanics)." But Mr. Lynch's plea for a wider and deeper application of the idea of an all-pervading Purpose is unconvincing, though rhetorical.

The idea of Will dominates the psychology of the day; it belongs, of course, to the Purpose-idea. We could wish that some critical philosopher, such as Mr. Russell, would subject it to a merciless analysis. The same may fitly apply to the philosophy of chance and probability. The papers on these subjects read before the Aristotelian Society show the over-elaboration which often precedes the simplification of an idea. In the first volume of "The Encyclopædia of the Philosophical Sciences" (2) there is a similar elaborate treatment of logic. Prof. Losskij thus states the "new conception of consciousness which is leading Philosophy out of the *cul-de-sac* of psychological Idealism": "Consciousness is the sum-total of everything which stands in a certain unique *relation* to the Ego. . . . Every fact of consciousness is made up of at least *three moments*; every such fact depends for its existence upon the presence of an Ego, of a content of consciousness, and of a relation between the two." This is the old logic writ large. Prof. Couturat more hopefully applies mathematics to the principles of logic. His notion of "propositional functions" is worth serious consideration. The plan of the Encyclopædia is suggested, no doubt, by the inconsistencies of the previous works. It consists, "not of brief articles summary in character, dealing with a great variety of topics, . . . but of original and relatively exhaustive discussions of fundamental aspects of each main subject." The index, significantly, is of authors only.

(3) Mr. Reinheimer agrees with the late M. Novikow in emphasising positive factors in evolution against such negative factors as selection by survival. According to Darwin, death is a main factor; nutrition and work, according to Mr. Reinheimer, are more important. His thesis is a good one; biological cooperation, similar to economic cooperation, must be taken into account. Nutrition represents stored-up organic capital. It is parallel to reproduction. He has interesting observations on the fallacy of in-feeding, which is parallel to in-breeding. The book is suggestive, but, as a key, it only unlocks a side-door of the subject. Some elaboration of the orthogenesis doctrine seems more likely to open the main portal.

(4) Mr. Jamyn Brooks has already received careful critical consideration. In "The Science of the Sciences" he undertakes to correlate the three principal sciences of "Chemistry, Physics, and Metaphysics, or Matter, Force, and Mind." Thus, in his first prefatory sentence, he shows confusion, which becomes worse confounded as the argument proceeds. If he has a new idea, he ought to explain it, but when about to explain he goes off at a tangent to something else. The one idea I have gathered is the existence of mental æther, corresponding to material! The author's notion of construction and expansion as primary motion, and of translation as secondary, is not new. As for the testing of the hypothesis, continually mentioned, it fails to materialise.

(5) Herr Meyer, on the evolution of mind, brings together the latest results of animal-psychology, and treats of them in reference to the human mind. His expository method has the merit of being general; he abstracts the insect's mental life and applies it, in comparison with man's, to the forms of thought, such as space and time. This is a big book, closely reasoned and most comprehensive.

(6) The distinguished botanist, the late Prof. Potonié, has written a charming series of "easy-chair" essays on science. The popularisation of science, the art of explanation, the power of habit, dogma and criticism, knowledge and belief, imagination and science, the concept of purpose, are old subjects treated with freshness. In subjects which bring science and society into relation he is not afraid to speak out.

A. E. Crawley.

OUR BOOKSHELF.

Das Relativitätsprinzip; die jüngste Modenarrheit der Wissenschaft. By Leo Gilbert. Pp. 124. Wissenschaftliche Satyren. Band I. (Brackwede i. W: Dr. W. Breitenbach, 1914.) Price 3 marks.

The satire as a means of propaganda for scientific ideas is not of modern usage. Fechner was probably one of the last scientific satirists. Its revival in the present instance is the result of the considerable amount of mystification to which the electromagnetic principle of relativity established by Lorentz, Einstein, and Minkowski has given rise. The description of this principle as "the latest fashionable craze in science" is rather cutting, but as the book is well written and easily read, we can imagine that it will increase rather than lessen the general interest in the work of those eminent theoretical physicists. That the more extravagant conclusions resulting from the extreme adaptations of the principle should be held up to ridicule is quite wholesome, as it reveals the weak points in the argument and prevents the unwary from carrying it too far.

After all, "relativity" is only one among many possible interpretations of the result of a more or less isolated experiment. It asserts that no electrical or optical experiments can ever reveal absolute motion, or show any variation in the velocity of light. It is Einstein's merit to have pointed out the alarming consequences which would result from these two simple propositions. Our notions of time and space become almost interchangeable, and the "present moment" becomes meaningless without considerable restriction so soon as relative motion is involved.

Leo Gilbert burlesques these innovations with much humour and ingenuity, and will no doubt largely prevent them being taken too seriously. Since Einstein himself has practically abandoned the principle of the apparent constancy of the velocity of light in all circumstances, and even his mathematical methods have failed to deal with accelerated motion, there is little left of the imposing mathematical superstructure, and what "craze" there was has given way before a sober appreciation of an interesting speculation on its merits. While enjoying the fun of the satire, we cannot say that the author is at all fortunate where he endeavours to furnish an alternative explanation.

Gipsy Coppersmiths in Liverpool and Birkenhead. By Andreas (Mui Shuko). Pp. vi + 66 + plates. (Liverpool: H. Young and Sons, 1913.) Price 1*s.* net.

THIS book is a collection of newspaper articles describing the manners and adventures of a band of gypsy coppersmiths, which appeared in Liverpool and Birkenhead in 1912. The writer would have been better advised not to reprint his material in this fragmentary form, but to take the opportunity of preparing a connected narrative. These people were commonly known in this country as Hungarians, but they were really cosmopolitan nomads from Eastern Europe. They settled in Liverpool, where they claimed superiority over the local gypsies, and, though they were lavishly supplied with money and jewelry, professed to make their living by repairing copper cauldrons. They can scarcely be described as attractive. They were most unwilling to give estimates of the cost of work entrusted to them. Like all Orientals they loved bargaining, made preposterous demands of payment for work entrusted to them, refused to be bound by any contract, and tried to enforce their claims by bullying and that form of coercion known to Hindus as "sitting *dharna*." They were shameless beggars, and one of their boys stole the ring of their English friend, and flourished it in his face as they departed by train *en route* to Buenos Ayres. In spite of all this, they had a remarkable sense of personal dignity, and their kindness to one of their boys stricken with epilepsy, for whose treatment sorcery combined with the best medical advice was used, was remarkable. On the whole, we can readily imagine that the people of Liverpool easily reconciled themselves to the departure of their visitors.

Prehistoric Times: as Illustrated by Ancient Remains and the Manners and Customs of Modern Savages. By the late Rt. Hon. Lord Avebury. Seventh edition, thoroughly revised and entirely reset. Pp. iii + 623. (London: Williams and Norgate, 1913.) Price 10*s.* 6*d.* net.

THIS, the seventh edition, "entirely reset," was revised by Lord Avebury only a few months before his lamented death. The author was a pioneer in the popularisation of the study of archæology. It is pleasant to be reminded: "This (the Drift period) I have proposed to call the 'Palæolithic' Period," and "For this (the Stone Age) period I have suggested the term 'Neolithic.'" The present edition is specially enriched with coloured illustrations of Palæolithic paintings. For the wide range of its information, and the fairness with which divergent views are discussed, the book well deserves the improved lease of life now given to it as a popular text-book of archæology. Its defects are those of its class. For certain reasons, one had been led to expect that in this edition the author would have set a fashion in works of the kind in including a summary of the astronomical evidence which is but rarely detached from archæological objects. The Stonehenge evidence, it is true, is now too well impressed on the popular mind to be overlooked (pp. 133-4), but it is severely isolated. It is in the interests of young readers or teachers of this text-book that one points to the latter half of the following passage as a questionable statement. "In this country we still habitually call the megalithic monuments 'Druidical,' but it is hardly necessary to mention that there is really no sufficient reason for connecting them with Druidical worship" (p. 126). JOHN GRIFFITH.

A Text-book of Organic Chemistry. By Prof. A. F. Hollemann. Edited by Dr. A. J. Walker, assisted by Dr. O. E. Mott. Fourth English edition, partly re-written. Pp. xviii + 621. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1914.) Price 10*s.* 6*d.* net.

THE first English edition of this work was reviewed in NATURE on June 18, 1903 (vol. lxviii., p. 149). One of the chief characteristics of the present issue is the additional space allotted to the applications in organic chemistry of physicochemical methods. The section on tautomerism has been re-written, and the chapters on the benzene derivatives have been re-arranged.

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.*]

New Units in Aerology.

IN NATURE of February 5, p. 629, is a reference to the new edition of the "Observer's Handbook" of the Meteorological Office, and complimentary mention of the proposed extension of c.g.s. units. On this side of the Atlantic, we have not yet seen the book, but feel that Dr. Shaw and his associates have with characteristic progressiveness done well in opening the campaign for the use of rational units. It will be hard for the present generation to depart from the old notation; but for those who are to follow, the adoption of these units means clearer conceptions of atmospheric motion, fewer mistakes, and great ease of compilation. Briefly, the units are those proposed by Köppen at Monaco in 1909, and advocated by V. Bjerknes at Vienna in 1912. Temperature is given in degrees Centigrade on the absolute scale, and pressure is recorded in *bars* and decimal parts thereof, as decibar, centibar, and millibar.

We began using these units at Blue Hill Observatory, January 1, 1914, and within a fortnight had our attention directed by Prof. Kennelly to the fact that unknown to meteorologists at home (and presumably abroad), the *bar* was in use and had an established meaning among chemists and others. If we continue its use without definition we only add to the confusion already existing.

So far back as 1888 the word *barad* was proposed by a committee of the British Association as a suitable term for the unit of pressure, one dyne per sq. cm. In 1903 Prof. T. W. Richards[1] independently suggested that the pressure of one dyne per sq. cm. be called a *bar*. He also suggested *megabar* for a c.g.s. atmosphere. So far as I can ascertain this is the first clear-cut definition of an absolute atmosphere. Ostwald in 1899 had the idea and advocated the use of one million of the units as a standard pressure, but gave no name to the large unit. Richards has used the bar consistently in his work, likewise Kennelly[2] and others. It has been definitely adopted by the International Congress of Physicists, independently of Richards's proposal under the name *barie* (see Guillaume's "Récents Progrès du Système Métrique," Paris, October, 1904).

It seems almost unnecessary to argue that the smaller bar should be the basic unit and not some multiple. And again, it is doubtful if bar is the most appropriate designation for the pressure of an absolute atmosphere. *Aer* is a more significant word. Megabar is not altogether inappropriate, and, as we have seen, is established in the literature of chemistry, and cannot readily be displaced. The megabar in the notation of the aerologist means the pressure of a million atmospheres, a magnitude not often dealt with; while on the other hand we sometimes need to express pressures smaller than the millibar of the aerologist. Now the bar of the chemist and physicist lends itself nicely to the measurement of these feeble pressures, since it is divisible down to its millibar, *i.e.* the thousandth of a dyne per sq. cm.

To contrast the two systems, I have made the following table, and at the suggestion of Prof. Richards have restricted it to the terms in common use.

Chemist and physicist (To be used by all hereafter)	Aerologist (To be abandoned)	Remarks
—	1 megabar	A million atmospheres; beyond direct measurement
1 megabar	1 bar	The absolute atmosphere; equal to 750·1 mm. Hg, or 0·987 of usual sea-level atmosphere. One megadyne per sq. cm. acting through 1 cubic cm. does 1 megerg of work.
1 kilobar	1 millibar	1 kilodyne per sq. cm.
1 bar	?	1 dyne per sq. cm. acting through 1 cubic cm. does 1 erg of work.

There could be no objection to giving the term megabar or absolute atmosphere some convenient nickname, such as "Aer," if megabar seems too ponderous. Prof. Richards has also suggested that for historical reasons the pressure of ten absolute atmospheres might be named after some pioneer in meteorology as Guericke or Torricelli or Pascal; but this need not be dwelt upon at present.

Fortunately we can change from the aerologist's system to that of the chemist by writing kilobar for millibar, and by substituting "aer" for "bar." This we are doing in the handy conversion tables now in course of preparation at this observatory.

Now is the time to agree upon a logical and available system. The megabar atmosphere seems to me to be the more appropriate; but perhaps some of the readers of NATURE can suggest something better.

ALEXANDER MCADIE.

[1] Pub. 7 Carnegie Inst., 1903, p. 43; also Jour. Am. Chem. Soc., vol. xxvi., 1904; T. W. Richards, W. K. Stull.

[2] Am. Inst. Elec. Engineers, June, 1909; Kennelly, Wright, and Van Bylevelt.

Weather Forecasting.

MR. MALLOCK quotes in NATURE of February 26 (p. 711) a sentence of the late Sir G. Airy concerning the amassing of millions of useless meteorological observations. Unfortunately, in scientific work a vast amount of work which is not immediately productive has to be done. Indeed, it is not possible to foresee with accuracy what the result of any particular investigation will bring forth. But I do not think that this feeling will deter scientific minds from working, for each advance beyond the frontiers which limit our knowledge makes up for the disappointment resulting from many apparently unsuccessful expeditions.

It is acknowledged that in this country, indeed in this latitude, the weather depends largely upon travelling cyclones which reach us from the Atlantic. Now our knowledge of the nature and origin of cyclones is very limited, and recent researches of the upper atmosphere have shown that a good deal of accepted theory concerning them is unsound. In spite of the millions of observations which have been, and are being, taken, we have no detailed information concerning the conditions obtaining in any one cyclone, and the changes which have occurred in it during its passage over the land or sea. In these circumstances it is not surprising that weather forecasting should be difficult and uncertain. Now whilst such a lamentable want of knowledge concerning atmospheric disturbances exists, it surely cannot be maintained that we already have too much information, and that further research is undesirable.

The main question really is as to the direction such further research should take. Dines enters a plea for further research concerning the condition of the upper atmosphere. Considering that it is this kind of work which has led to such great changes in our views concerning the theory of cyclones, etc., it is reasonable to suppose that still further investigation in this direction would lead to further advances, and that, therefore, the work is one which deserves encouragement in a practical way. My own plea, which gave rise to this discussion, was for better daily charts. At the present time millions of observations are practically buried so far as the individual meteorologist is concerned. A large part of these could be put on the charts and rendered available for all. My suggestion as to the Daily Weather Charts was, that the *wind provinces* should be put in. I found that, even with the information now published, it was possible to do this with fair accuracy during a period of about ten weeks. With a few more wind observations plotted on the diagrams it would be possible to do this accurately. Then the isotherms and humidities of each wind province could be put on the chart. The isobars run from one wind province to another in continuous curves. This is not the case with the isotherms—they terminate more or less abruptly, as do the humidity curves, at the borders of the wind provinces. The winds and isotherms taken together, therefore, render it possible to draw the wind provinces with some accuracy.

It seems probable that daily charts with all the details that have been enumerated plotted on them would not entail great expense, would very likely teach us a great deal concerning cyclones and anticyclonic areas, and prevent so much valuable detail of atmospheric change being buried on the shelves of our institutions and societies.

R. M. DEELEY.

Abbeyfield, Salisbury Avenue, Harpenden, February 28.

The Doppler Effect and Carnot's Principle.

So many objections, based on the Doppler effect, have been made to my application of Carnot's principle to each particular frequency in full radiation, that it seems necessary to show that the two methods are not mutually inconsistent.

According to the Doppler effect, when a beam of light q_1 per sq. cm. per sec. moving with velocity c is directly reflected by a mirror moving with velocity nc in the same direction, the frequency of every component in the beam is reduced by reflection in the ratio $(1-n)/(1+n)$, which according to Wien's displacement law is also the ratio T_2/T_1 of the temperatures of the reflected beam q_2 and the incident beam q_1. The net expenditure of energy by the radiation per sec. per sq. cm. is q_1-q_2, which reduces to $4nq_1/(1+n)^2$, since the energy density varies on reflection as the square of the frequency. Part of this energy $(q_1+q_2)n$, is left in the space nc vacated by the mirror per second. The remainder, $2nq_1(1-n)/(1+n)$, is equal to the work done by the radiation pressure p, namely, pnc per sec. per sq. cm. We thus obtain $p=2q_1T_2/cT_1=2q_2T_1/cT_2=2\sqrt{q_1q_2}/c$, which is true for every component separately, and gives in the limit $p=2q/c$ when the motion is slow, and the incident and reflected beams become equal.

The energy left in the medium, $(q_1+q_2)n$, does *not* give rise to a volume of stationary vibration, unc, where $u=p=2q/c$, as commonly assumed, because the frequencies of each component before and after reflection are essentially different on account of the Doppler effect. In order to find the stationary vibration, or the intrinsic energy-density u in the state of equilibrium, we must combine each incident ray with a reflected ray of *the same frequency, before* taking the limit. For any component q in the incident beam, the energy-stream of the component having the same frequency in the reflected beam is $q-(dq/dT)_\nu dT$, where $dT=2nT$ when n is small, and $(dq/dT)_\nu$ is the rate of increase with temperature of an energy-stream of constant frequency ν. The net energy supplied of a particular frequency is $2nT(dq/dT)_\nu$ per second, and is equal to $(u+p)nc$. But since $p=2q/c$, this reduces in the limit to exact agreement with Carnot's principle, $T(dp/dT)_\nu=u+p$; which applies correctly to the equilibrium state.

H. L. CALLENDAR.

Ligament Apparently Unaltered in Eocene Oysters.

DURING the examination of some large specimens of *Ostrea bellovacina*, Lam., from the Woolwich beds, sent on February 20 to this office by Mr. A. G. Davis, of Beckenham, a very interesting case of the preservation of what appears to be organic tissue in an unaltered state has come to light.

The ligament in the two specimens examined has a remarkably fresh appearance, and in its aspect and texture compares so closely with that of a recent oyster as to suggest that the fossil specimen has undergone no change, except that it is somewhat softer and the fibres are less coherent.

The whole of the ligament has been removed from one specimen and preserved in spirit, and a portion will be embedded in paraffin and sections cut for microscopical examination.

The specimens were obtained from the lowest bed of the following section :—

Excavation for Sewer in the High Street, Beckenham.

	Soil	3 ft. 0 in.
Oldhaven and Blackheath Beds	Buff coloured sand with scattered pebbles; Pale grey sand with seams of clay, the lower part ferruginous, with wood and iron pyrites	9 ft. 0 in.
	Cyrena and Ostrea bed with some pebbles	1 ft. 0 in. to 1 ft. 6 in.
Woolwich Beds	Bluish grey clay with broken Cyrena; Bluish grey sandy clay with Ostrea	2 ft. 0 in.
	Bluish grey mudstone and muddy sand slightly cemented. Ostrea, Modiola, etc.	Base not cut through

The preservation of organic tissue in fossils is so extremely rare that this instance is worth recording. Further examination is being made.

R. W. POCOCK.

Geological Survey, Jermyn Street, S.W., March 13.

Experiments Bearing upon the Origin of Spectra.

IN connection with Prof. Strutt's letter under the above title in NATURE of March 12, it may be of interest to direct attention to some previous work of Prof. Lenard's which contains results bearing on the same subject. Lenard (*Annalen der Physik*, vol. xvii., 1905, p. 197), as a result of a study of the light emission of the electric arc and the Bunsen flame containing metallic salts, showed that the principal and subordinate series are emitted by different distinct regions of the luminous source, and are thus due to different centres of emission. Further, he demonstrated that the centres emitting the different series behave differently in an electric field, and came to the conclusion that while the centres which emit the principal series are neutral metallic atoms (as has been also contended by Wien for the canal rays), the centres of the subordinate series are atoms rendered positive by the loss of one or more electrons, one for the first series, two for the second, and so on. This theory is strikingly borne out by Prof. Strutt's experiments, all of which seem to be explicable by it; in any case, this independent confirmation seems to place beyond doubt the different electrical state of the centres emitting the different series.

E. N. DA C. ANDRADE.

University of Manchester, March 13.

The First Description of a Kangaroo.

I HAVE just read in NATURE of February 26 (p. 715) a letter by Mr. W. B. Alexander concerning the discovery of Australia and the first description of a kangaroo. It is stated there that the first discovery of this animal was made, not by Sir Joseph Banks on Captain Cook's first voyage in 1770, but by Pelsart in 1629. May I be allowed to point out that a description of a kangaroo is to be found at a much earlier date, viz., in the "Decades" of Peter Martyr, published shortly after 1500. Unfortunately this book is not accessible to me at present, so I must only point to numerous publications of Mr. Edward A. Petherick, of the Federal Government Library, Melbourne, concerning the discovery of Australia, who claims this honour for Amerigo Vespucci. According to Mr. Petherick, Peter Martyr states that in 1499 a southern coast was discovered (probably by Vespucci) in which trees grew of such magnitude that sixteen men standing around one could scarcely encompass it (this would correspond to south-west Australia, between King George's Sound and Cape Leeuwin). Amongst these big trees was found a monstrous beast, with the head of a fox, the hands of a man, the tail of a monkey, and that wonderful provision of nature, a bag in which to carry its young. The beast so described was caught alive with its young, but during the long voyage both died. The carcase of the dam was taken to the Court of Ferdinand and Isabella in the year 1500. This description is not as detailed as that by Pelsart; nevertheless it cannot easily be doubted that it refers to a kangaroo, which seems to have been known for the first time so far back as the end of the fifteenth century.

The coast in question is supposed to have been discovered by Diego de Lepe, whose pilot was Vespucci.

TAD. ESTREICHER.

Laboratoire de Chimie II., Université de Fribourg (Suisse), March 3.

The Movements of Floating Particles.

WILL any physicist be good enough to explain the following to an ignorant amateur? If a clean saucer be half-filled with a decoction of tea on the surface of which bubbles or unwetted shreds of ash (as from the consumed paper round the lighted end of a cigarette) are floating but not in a continuous layer, then if the decoction, after coming to rest, be gently rocked the floating particles will partake of its perpendicular, but little, if at all, of its lateral motion. Sunken particles, on the other hand, will partake of the lateral motion. Again, if the saucer be gently tilted the fluid will flow away, but each floating particle will remain stationary, and will be deposited under its original position.

Why do not the particles partake of the lateral motion? Does the surface of the decoction form an incompressible, but flexible, film, which (in the saucer) may be added to but not subtracted from, under which the rest of the fluid slides with little friction. And when the fluid flows away does this film remain behind to form that portion of the fluid that wets the saucer? Or do solid, but invisible, particles come up and form a continuous sheet on the surface? Against the latter supposition is the fact that particles dropped on the advancing edge of the decoction remain stationary. Particles floating on the surface of ordinary tap water move with it much more freely; water in which table salt has been dissolved behaves like tap water. But even in sea water we see froth left behind by receding ripples.

G. ARCHDALL REID.

"Netherby," 9 Victoria Road South, Southsea. March 13.

KINEMATOGRAPHY AND ITS APPLICATIONS.[1]

MR. TALBOT is to be congratulated on having produced a book which must appeal strongly to the interest of the general reader, even though he may have no intention whatever of becoming a "kinematographer." A word here on this terrible term. It may be correctly derived from the Greek, while it certainly admits of many pronunciations, variously wrong, but the frequent collision with these six syllables when otherwise interested must impress upon the reader of Mr. Talbot's book the desirability of finding some new word of one syllable, not derived anyhow, such, for instance, as the mechanic and the electrician have found in the words crank and boost, so that neither attention may be arrested nor printing ink and paper wasted.

The main purpose of the book is to show what has been done in many different fields and the nature and cost of the apparatus which an amateur would be likely to use, rather than to give instruction in the details of the art. Incidentally, the commercial value of lucky-chance films of the amateur is pointed out, but it is not very clear what the cost of the unlucky-chance miles of film that will be worth nothing is likely to be.

On first opening the book the reader will see a picture of a fine cow which appears to have suffered at the hands of the cattle-maiming gang. Closer inspection will show that the injury is a door in the side of the beast, which, according to the legend below, is 15 ft. high. It was made by Messrs. Newman of *papier-mâché*, so that the operator might get inside with his camera with the intention of taking lions and other beasts unawares. Passing on from this testimonial to the credulity of the savage beast, we find numerous full-page or half-page enlargements of single pictures taken from the strip, so perfect in focus and detail that it is scarcely possible to believe that it has all been derived from a miniature $1 \times \frac{3}{4}$ in. only in size. A reference to some of these only will indicate the great variety of subject which is open to those who practise this new art. There are lions at lunch in the jungle, a polar bear diving in the arctic sea, birds feeding their young, a vulture preparing to fly, and taken at such close quarters that every feather is clearly defined, eighteen successive photographs taken during a single beat of a pigeon's wing, and fifteen of the opening of a convolvulus, both from the Marey Institute, two X-ray films from the same institute by M. Cavallo, one of sixty pictures showing digestion in the intestine of a frog, and thirty of the movements of the gizzard in a fowl, and others from the same quarter.

Then by the aid of the microscope and the "ultra-microscope," smaller forms of life may be seen in motion. For instance, there is the head of a spiny monster which is nothing more than a blue-bottle eating honey from off a needle, and there might have been, but are not, illustrations

[1] "Practical Kinematography and its Applications." By Frederick A. Talbot. Pp. xii+262+plates (London: W. Heinemann, 1913.) Price 3s. 6d. net.

of the blood corpuscles, phagocytes, and microbes in human blood in a state of violent activity and warfare. Then there is a group of pictures taken from an American film, which was produced with the object of showing the actual movements of a highly-skilled mechanic, so that those who take too long about their work might learn how to avoid useless movements. There is an account of the beautiful instrument of M. Bull described in NATURE of July 28, 1910 (vol. lxxxiv., p. 112), by means of which stereoscopic pictures may be taken at the rate of 2000 a second of such objects as a fly flying; and the somewhat similar apparatus of Prof. Cranz is also described. There is also an account of the most startling development of kinematography. It is called the "Life Target." In this device a moving picture is projected on the screen; it may be, for instance, of cavalry crossing the screen or of an elephant charging straight at the spectators. These are provided with rifles and shoot at the screen. The explosion wave, by suitable mechanism, causes the film to be arrested for an instant only, when the bullet hole is clearly seen as a white spot, which disappears when the film continues its movement. Other interesting pictures show the hatching of a chick, a fight between a lobster and an octopus, and many other things.

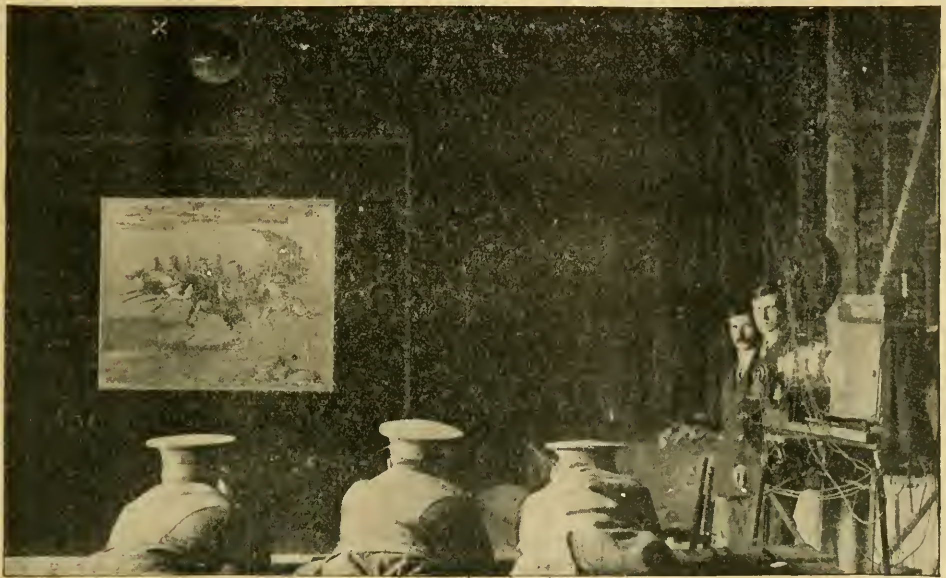

FIG. 1.—Soldiers firing at the "Life Target." The picture on the screen is thrown from the projector at right, and the picture is held stationary by the action of the report of the rifle caught by the microphone (marked ×) upon the lantern mechanism. From "Practical Kinematography and its Applications."

A very good account is given of the construction of several of the simpler machines, and in particular of the "Aeroscope," or moving-picture camera, in which air previously compressed in a light tubular reservoir by means of a bicycle pump drives a minute engine and so moves the mechanism at the desired rate, while the operator, having both hands free, may hold the machine up over his head in a crowd and secure at close quarters some stirring incident. It is with this instrument that Mr. Cherry Kearton has obtained some of his most wonderful results.

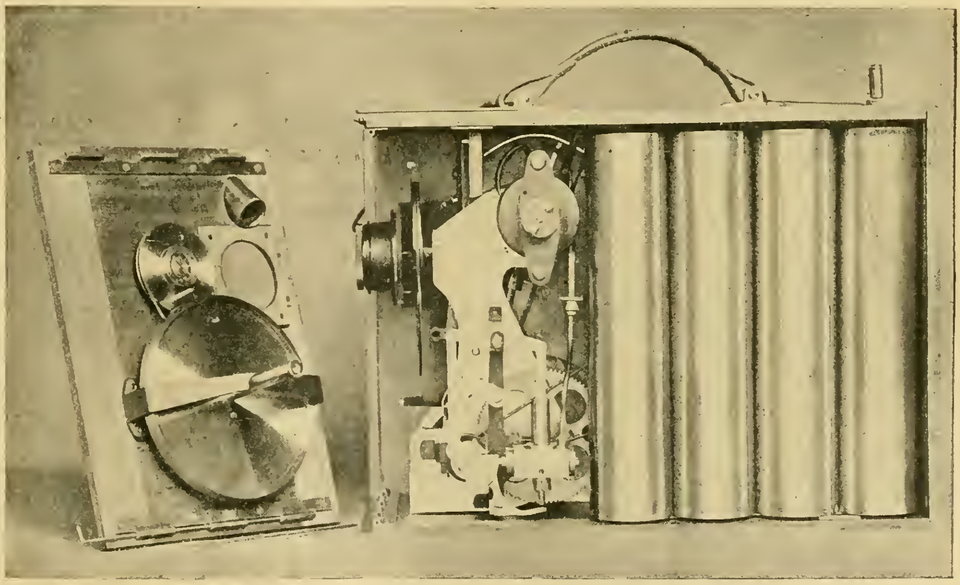

FIG. 2.—The compressed air reservoirs of the "Aeroscope" camera. One charge is sufficient to expose 600 ft. of film. From "Practical Kinematography and its Applications."

The methods used for developing and printing, of course, are described, but, curiously, no mention is made of colour work, whether two colour such as is so popular at the Scala Theatre, or three colour as represented a year or two ago at the Royal Institution by M. Gaumont, with such amazing fidelity to the colours of Nature.

Space is not available for more than a bare recitation of some of the things described or illustrated; sufficient, however, has been said to show that a most interesting and attractive book has been produced.

On p. 171 reference is made to a difficulty met with when photographing live microbes in consequence of their being killed by the heat from the concentrated beam from the powerful arc lamp. The use of a water cell in the beam is described as a method of reducing this trouble. While the ever-repeated fallacy of alum solution finds no place here, the author or Dr. Comandon, whose work is being described, do not appear to have known of the use of freshly-prepared solution of $FeSO_4$, of such a strength that its colour is just visible, as an effective heat absorber.

C. V. BOYS.

EARLY FOSSIL BRACHIOPODS.[1]

THE work before us, which treats of the Cambrian brachiopods of the whole world, must arouse the admiration of all who understand the difficulties of a comprehensive palæontological study of such magnitude. It is a splendid monument to the ability and perseverance of its eminent author, whose previous reputation as an investigator of the Cambrian faunas was so widely established as not to need the further proof afforded by these two handsome volumes. It is a matter both for surprise and congratulation that Dr. Walcott has found opportunity, amidst his many activities, to bring to completion a task so overwhelming: small wonder that it has occupied his available time for ten years or more.

If the wealth and good preservation of the Palæozoic Brachiopoda found in North America has provided an abundance of material favourable for study, how worthily have the palæontologists of the United States utilised their advantages! It may be granted that they owe some measure of their success to generous practical support and to freedom from conservative traditions in the matters of outlook and treatment of their subjects: these are advantages denied to most workers in Europe. Yet no consideration of such favouring circumstances can diminish our indebtedness to those brilliant investigators in the United States who have contributed so largely to the rapid advancement of modern palæontology in all its branches. For models of comprehensive systematic work, for suggestive and original phylogenetic studies, and for inspiring aid in applying the facts of palæontology to many problems of philosophic biology, we in Europe have become more and more accustomed to look westward. Dr. Walcott is one among several of his compatriots who have advanced our knowledge of the Palæozoic brachiopods in an extraordinary degree.

It is impossible for a single reviewer either to criticise in detail a work of such wide scope as the present monograph or to do justice to its merits. It must therefore suffice to indicate briefly some of its special features. In this book are described "44 genera, 15 subgenera, 477 species, and 59 varieties of Cambrian Brachiopoda," and "3 genera, 1 subgenus, 42 species, and 1 variety of Ordovician Brachiopoda." The descriptive part of the text occupies nearly 500 pages; yet, bearing in mind that this will remain the standard work of reference on the Cambrian brachiopods of all countries for many years to come, the author appears to have erred on the side of brevity. There are instances where the specific characters might with advantage have been set out more fully and the comparative observations amplified, though the appearance of an unduly meagre treatment may sometimes be owing to limitations in the material itself. The whole descriptive portion of the work affords ample evidence of the author's extensive knowledge and scholarly thoroughness. The 76 figures, chiefly in half-tone process, which are scattered throughout the text are clearly reproduced, while the letterpress is very well printed and edited.

The various tables in which are set forth synonymic references and the geographical and stratigraphical distribution of the brachiopods, are outstanding features of the work. The table of synonyms, giving the names now adopted set in a column alongside those previously applied to the same species, will be of great service to all workers in this field of study. Geographical distribution is shown in a synoptic table arranged according to continents and faunal provinces (pp. 114–122). Another elaborate table, giving the detailed stratigraphical distribution of the Cambrian and some Ordovician species, occupies 34 pages. This is arranged alphabetically according to states or countries, and contains a vast amount of concisely arranged information. Here are included summaries of many local or regional sections, with references to individual localities which are described in detail on subsequent pages: also lists of the brachiopods found at the various horizons and certain leading species of other classes.

The section of the work headed "Zoological Discussion" (pp. 291–326) is of importance to all students of the Brachiopoda. Here are to be found terminological definitions and an account of the morphological characters of the shells; also short chapters on evolution and classification, which strike us as unduly condensed. The bibliography (pp. 13–26) is very full, and should prove of great help to other workers. We miss here a reference to Mr. F. R. C. Reed's memoir on "The Cambrian Fossils of Spiti" (Palæontologia Indica), published in the summer of 1910, and the species of brachiopods there recorded are omitted from the descriptive portion of the text. Presumably that work appeared too late to be utilised;

[1] "Cambrian Brachiopoda." By Charles D. Walcott. Monographs of the United States Geological Survey, vol. li.: part i., pp. 872+76 figs.; part ii., pp. 363+civ plates. (Washington: Government Printing Office, 1912.)

but if this be the case, two years seems a too generous allowance of time to be occupied in passage through the press, to the exclusion of belated additions, even in the case of an elaborate monograph such as that under review. The volume of text concludes with a full and well-planned index, while there is the useful luxury of a second index at the end of the volume of plates.

Special praise must be accorded to the plates, upwards of 100 in number, which illustrate this work. These are well reproduced in collotype process from beautifully executed drawings, mainly by Miss Frances Wieser, of the United States Geological Survey. The careful and detailed work of the artist is a fine achievement. To many who have little acquaintance with the Cambrian brachiopods beyond the scanty assemblage found in our own country, the perusal of this volume of plates will prove a revelation. It is indeed astonishing to find that such a profusion of species had been evolved and such elaborate specialisation had been attained by many of them in those remote ages. One can only picture in imagination the long and slowly evolving lines of precursors of which no trace has yet been found.

Dr. Walcott deserves the warmest thanks of all palæontologists and geologists for a treatise which must long remain a classic. The public department which has issued the work in such handsome form is also to be congratulated. What higher service can such a department perform than thus to give practical encouragement to arduous scientific labour? F. L. K.

THE TRANSMISSION OF PLAGUE BY FLEAS.

THE third Plague Supplement of the *Journal of Hygiene* maintains the high standard both of research and of editing set by the previous numbers. It contains eight good articles, chiefly by S. Rowland and R. St. John Brooks, on the bacteriology of plague and by A. W. Bacot on the rat flea. The former articles deal with the influence of cultivation in serum-containing media upon the virulence and immunising properties of the plague bacillus; upon the facility with which it is ingested by human leucocytes; and upon its virulence—all points of importance in regard to bacteriology in general. Mr. Bacot's most laborious and well-set-out researches upon the influence of temperature and humidity upon the pathophores and on the effect of vapours as insecticides deserve much commendation; but perhaps the most interesting article is by him and Prof. C. J. Martin on the mechanism and transmission of plague by fleas. They sum up a very careful paper by the following remarks:—

"Under conditions precluding the possibility of infection by dejecta it was found that two species of rat fleas, *Xenopsylla cheopis* and *Ceratophyllus fasciatus*, fed upon septicæmic blood, can transmit plague during the act of sucking, and that certain individuals suffering from a temporary obstruction at the entrance to the stomach were responsible for most of the infections obtained, and probably for all. In a proportion of infected fleas the development of the bacilli was found to take place to such an extent as to occlude the alimentary canal at the entrance to the stomach. The culture of pest appears to start in the intercellular recesses of the proventriculus, and grows so abundantly as to choke this organ and extend into the œsophagus. Fleas in this condition are not prevented from sucking blood as the pump is in the pharynx, but they only succeed in distending an already contaminated œsophagus, and, on the cessation of the pumping act, some of the blood is forced back into the wound. Such fleas are persistent in their endeavours to feed, and this renders them particularly dangerous." R. R.

NOTES.

WE announce with deep regret the death on March 16, as the result of a motor accident, of Sir John Murray, K.C.B., F.R.S., the distinguished naturalist and oceanographer.

THE Right Hon. Sir Francis Hopwood has been appointed by the president and council of the Royal Society to a seat on the general board and executive committee of the National Physical Laboratory, in succession to Sir Arthur Rücker, F.R.S., resigned.

WE notice with regret a Reuter message from New York reporting the death on March 16 of Prof. E. S. Holden, director of the Lick Observatory from 1888 to 1898, and author of a number of papers and other works on astronomical subjects.

THE death is announced, on March 7, at seventy-three years of age, of Prof. Antonino Salinas, professor of archæology at the University of Palermo and director of the Archæological Museum.

PROF. J. G. ADAMI, F.R.S., Strathcona professor of pathology and bacteriology, McGill University, Montreal, has been awarded the Fothergill gold medal of the Medical Society of London for 1914, for his work on pathology and its application to practical medicine and surgery.

THE death is announced, in his sixty-seventh year, of Dr. E. J. Houston, one of the inventors of the Thomson-Houston system of arc lighting. He was twice elected president of the American Institute of Electrical Engineers, and was the author of more than fifty books, mainly on electricity and allied subjects.

PROF. F. KEEBLE, F.R.S., professor of botany, University College, Reading, has been appointed director of the Royal Horticultural Society's garden at Wisley, with the view of making it of more general practical service. Mr. F. Chittenden will remain in charge of the educational section, and Mr. S. T. Wright will continue to act as superintendent of the garden.

MISS A. CANNON, whose critical examination of Harvard College Observatory photographs has led her to the discovery of many new variable stars and other objects of interest, has been elected an honorary member of the Royal Astronomical Society. At the meeting of the society on Friday last, the president, Major E. H. Hills, in announcing the council's decision, remarked that Miss Cannon had acquired remarkable skill in distinguishing the type to which a star spectrum belongs and had completed the classification of 150,000 stars in this way.

MR. MARCONI appears to have secured some remarkable results with his new wireless telephonic apparatus. According to the daily newspapers, experiments have been carried out from Italian warships off the Sicilian coast, and on one occasion signals were received from Canada, 4062 miles away, by means of wireless telephony. In another experiment communication was set up between two ships forty-five miles apart, and the connection continued uninterruptedly for twelve hours. On March 14 the wireless telegraphic station at Nauen, near Berlin, exchanged clear signals with the Windhuk station in German South-West Africa, a distance of more than 6000 miles.

WE regret to announce the death, on March 15, of Dr. Harry Burrows, senior lecturer on chemistry at the Sir John Cass Technical Institute, at the early age of forty-two. Dr. Burrows received his academic training at the Royal College of Science and at Heidelberg University, and was a research scholar and subsequently an assistant demonstrator at the Royal College under Sir William Tilden. For the past ten years he had been on the staff of the Sir John Cass Technical Institute, where his successful work as a teacher was valued and appreciated both by the governors of the institute and by the students. Dr. Burrows contributed several papers to the Transactions of the Chemical Society.

THE Faraday Society has arranged a general discussion on optical rotatory power, to be held in the afternoon and evening of Friday, March 27, in the rooms of the Chemical Society, Burlington House, London, W. Prof. H E. Armstrong will preside at the afternoon session, and will deliver an introductory address. Prof. Percy F. Frankland will preside at the evening session. Papers on various aspects of the subject will be read by Prof. Hans Rupe (Basle), Prof. H. Grossmann (Berlin), Prof. Leo Tschugaeff (St. Petersburg), Dr. Darmois (Paris), Dr. T. M. Lowry, Mr. T. W. Dickson, Mr. H. H. Abram, Dr. R. H. Pickard, Mr. J. Kenyon, and Dr. T. S. Patterson.

THE Royal Society for the Protection of Birds has issued a manifesto signed by the president (the Duchess of Portland) and other ladies of distinction in favour of the Importation of Plumage Prohibition Bill now before Parliament. The manifesto says :—"The present Bill is the result of careful and prolonged investigations. The export of the plumage of wild birds has been prohibited from India, and from the majority of the Crown Colonies. The United States of America and the Commonwealth of Australia have sifted the question, and passed laws prohibiting both export and import. A strong feeling in favour of legislation on these lines is growing in Germany, France, Austria, Holland, Sweden, Denmark, and Belgium. Attempts to regulate the traffic would be futile on account of the insurmountable difficulties with respect to laws and their enforcement in the countries from which a large proportion of the birds come; therefore, the most effectual way to preserve wild birds is by the enactment of laws prohibiting importation in support of the regulations which forbid export."

THE report of the Royal Society for the Protection of Birds, presented to the meeting held at the Westminster Palace Hotel on March 5, shows that the growth of the society has been well maintained. Further funds are required if the society is to do the work which lies before it. "The watchers' committee is continually asked to undertake fresh work and accept new responsibilities; educational work could proceed far more rapidly were there funds for its support; it is probable that the work at the lighthouses will demand large additional outlay; and the legislative work before the society for 1914 is the heaviest it has yet had to encounter." The work at the lighthouses, it may be explained, takes the form of erecting rails on which flights of migrants may perch.

UNDER the powers of the Ancient Monuments Consolidation and Amendment Act, 1913, the following Advisory Boards have been appointed for England, Scotland, and Wales :—*England*—Mr. Lionel Earle (chairman), Lord Burghclere, Lord Crawford, Sir Aston Webb, Mr. R. Blomfield, Sir C. Hercules Read, Mr. C. P. Trevelyan, Prof. F. J. Haverfield, Prof. W. R. Lethaby, Mr. R. A. Smith. *Scotland*—Sir John Stirling-Maxwell, Bart. (chairman), Sir Herbert Maxwell, Bart., Mr. A. O. Curle, Dr. G. Macdonald, the Hon. Sir Schomberg K. McDonnell, Sir James Guthrie, Sir Robert Lorimer, Mr. J. R. Findlay. *Wales*—Sir E. Vincent-Evans (chairman), Lieut.-Col. W. E. Ll. Morgan, Mr. W. Edwards, Sir E. Stafford Howard, Mr. E. Neil Baynes, Prof. R. C. Bosanquet, Dr. W. E. Hoyle, Prof. J. Edward Lloyd. Mr. C. R. Peers, Chief Inspector of Ancient Monuments, is also a member of each board.

THE death is announced of Mr. George Westinghouse, the inventor of the air brake. Born at Central Bridge, Schoharie County, New York, in 1846, he was educated at public and high schools, and at Union College, where he graduated Ph.D. The air brake which has made his name famous throughout the world was invented in 1868. It has been computed that Mr. Westinghouse's genius as an inventor has brought into being undertakings with a capital of 130 millions of dollars, giving employment to 50,000 skilled artisans. He founded works in many American centres, as well as in Manchester and London, at Havre, and in Germany, Russia, Austria, and Italy. Among the decorations bestowed on him were the Legion of Honour, the Order of the Royal Crown of Italy, and of Leopold of Belgium. He was also the recipient of the Edison gold medal in 1912, and in the following year of the Grashof gold medal, conferred annually by the engineering profession of Germany in memory of Franz Grashof.

A PARAGRAPH in the *Times* of March 12 records the arrival at the Natural History Branch of the British Museum of a consignment of specimens illustrating the whales of the Antarctic. They were obtained by the museum taxidermist who accompanied the late Major Barrett-Hamilton to South Georgia, and were brought home *gratis* by Messrs. Salvesan, of Leith, their united weight being about 8 tons. The specimens—which represent three species, namely, the blue or Sibbald's rorqual (*Balaenoptera sibbaldi*), the common finner (*B. musculus*), and the southern humpback (*Megaptera lalandei*)—include the whalebone, flippers, a trunk-vertebra, and ear-bones. Plaster casts of the flippers are now being made, which will in due course be placed on exhibition. The blue rorqual was the second largest specimen on record, measuring close on 100 ft. in total length. To this species pertains the aforesaid vertebra, which is of enormous dimensions, largely exceeding those of the vertebræ of the sauropod dinosaurs from the Wealden of the Isle of Wight.

THERE is something reminiscent of a Latin-American frontier dispute in the controversy which has arisen regarding the base in the Weddell Sea of the respective Antarctic expeditions of Sir Ernest Shackleton and Dr. Koenig, but the parallel unfortunately does not hold good so far as to suggest arbitration by an impartial umpire. It is admitted on Dr. Koenig's side that, before his expedition was spoken of, Sir E. Shackleton had expressed in general terms his hope of undertaking a journey from the Weddell Sea to the pole. Dr. Koenig, on the other hand, produced detailed plans before Sir E. Shackleton did so, and the question turns simply on a point of opinion whether the latter's previous general statement gives him a basis of claim to priority, or not. The Royal and Imperial Geographical Society in Vienna has committed itself to the negative opinion, and there the matter appears likely to rest: either side may claim what it will but cannot enforce any claim upon the other; so that so far as concerns work in the Weddell Sea area (for the published statements do not make it clear that a crossing of the Antarctic continent is part of the Austrian, as it is of the British, scheme) science may be compelled to fall back upon any satisfaction and value which it may be possible to derive from a comparison between independent sets of observations in the same field.

THE concluding meeting of the Optical Convention was held on Thursday, March 12, in connection with the meeting of the Optical Society of that date. The report presented contained many points of special interest, conspicuous among which was an experiment made by the Board of Education in accommodating the exhibition of the Optical Convention in the buildings of the Science Museum at South Kensington. The experiment appears to have given complete satisfaction to the committee and members of the convention. We believe that it is regarded as having been successful by the authorities of the museum, and as it is very evident that such an employment, when practicable, of our public museums must tend materially to enlarge their usefulness, it may be hoped that the precedent will not be lost sight of in the future. From another point of view the report must have been equally satisfactory to the members of the convention, for it appears that in the result the committee has been able to wind up the business without making any formal call upon its guarantors. The most important outcome of the convention was the formation of a technical committee charged with the duty of establishing an effective cooperation between the users of scientific instruments on one hand, and the manufacturers of such instruments on the other. The report of that committee, which was the most interesting feature of the proceedings, shows that the committee found some very useful work ready to its hand in connection with a communication from the War Office referring to the standardisation of the cells and other parts of telescopes and binoculars. A sub-committee has been formed to consider the matter, and it is hoped that through the instrumentality of the Optical Society, and with the cooperation of British manufacturers of telescopes and binoculars, the necessary work of standardisation will soon be carried out.

IN connection with the Panama-Pacific International Exposition in San Francisco next year, there will be an International Engineering Congress, during the week September 20–25, 1915, in which engineers throughout the world, representing all branches of the profession, are invited to participate. The congress is to be conducted under the auspices of five engineering societies, namely, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers. Colonel G. W. Goethals, chairman and chief engineer of the Isthmian Canal Commission, has consented to act as honorary president of the congress. The general field of engineering to be covered by the congress has been divided into ten groups or branches, which, together with the special field of the Panama Canal, will constitute eleven divisions or sections, as follows:—(1) The Panama Canal; (2) Waterways and Irrigation; (3) Railways; (4) Municipal Engineering; (5) Materials of Engineering Construction; (6) Mechanical Engineering; (7) Electrical Engineering; (8) Mining Engineering and Metallurgy; (9) Naval Architecture and Marine Engineering; (10) Military Engineering; (11) Miscellaneous. The offices of the committee of management of the congress are at Foxcroft Buildings, San Francisco, Cal., U.S.A.

MR. B. QUARITCH, of 11 Grafton Street, London, W., is about to publish an elaborate work entitled "British Flowering Plants," in four volumes, royal quarto, at twelve guineas if ordered before the date of publication, March 28, or fifteen guineas after that date. The main feature of the work consists in three hundred coloured plates, reproduced from water-colour drawings by Mrs. Perrin. Copies of the first volume of the work, together with the original drawings, and the plates for the book, are on view (March 13-27) at the Dudley Gallery, 169 Piccadilly, where we inspected them on Saturday last, and were equally struck by the beauty of the original drawings and the remarkable fidelity of the plates reproduced from them. Thirty of the plates consist of floral dissections, but those inspected were somewhat too small and lacking in detail to be of much service to the student; such analytical illustrations are usually better done in black and white, except where they are on a large scale, as in the well-known coloured sections of flowers given in Dr. Church's "Types of Floral Mechanism." The British flowering plants are receiving a large amount of attention from artists and photographers at the present time, and the appearance of so many attractive books is a welcome sign of increasing interest in our wild flowers, while it should swell the numbers of field naturalists.

Mr. Arthur MacDonald, of Washington, D.C., has sent us a leaflet entitled "The Study of Man," the object of which is to urge the desirability of laboratories to investigate the bodily and mental characteristics of the criminal, pauper, and defective classes. This leaflet he has sent to the Home Secretary, Mr. McKenna, with a letter directing his attention to the importance of such work as a means of throwing light on the causation of crime, and as likely to furnish a more rational basis for methods of reform. With Mr. MacDonald's object we are in complete agreement, but in fairness to the Home Office it must be said the claims of the anthropological and psychological study of criminals have already met with some official recognition, as is evidenced by the recent publication in the form of a Blue-book of "The English Convict," by Dr. Goring, the deputy-medical officer of Parkhurst Prison. Yet the contents of this memoir are perhaps the most convincing indication that could be brought forward of the need for the establishment of laboratories, each equipped, not necessarily with costly and elaborate apparatus, but certainly with a properly qualified staff. For Dr. Goring's results clearly demonstrate the importance of the problems depending for their solution on work of this nature, while at the same time the poverty of the psychological data which he had at his disposal indicates the need for more advanced experimental work as to the mental nature of criminals.

In the issue of *Man* for March Sir H. H. Johnston discusses the origin of the horse-shoe arch. He suggests that it and the Mahràb, or holy recess, in the Mohammadan mosque, were based on a Phœnician sex-cult introduced into the West by Phœnicians, and that the horse-shoe arch, under their influence, may have arisen independently in southern Spain as it likewise arose in Cœle-Syria and southern Tunis. "But if so," he adds, "it is perplexing to find it as a pre-Islamic feature in Visigothic buildings of *northern* Spain, whither the Phœnician influence can have scarcely penetrated."

Prof. Arthur Keith's discourse on an anthropological study of some portraits of Shakespeare and of Burns, delivered at the Royal Institution on February 20, is printed in the issue of the *British Medical Journal* for February 28. In the case of Shakespeare, Prof. Keith uses a terra-cotta mask recently found in one of the midland counties, the bust in the church at Stratford, and the Droeshout portrait; for Burns a cast of the poet's skull in the possession of Mr. Barrington Nash, and portraits by Raeburn and Nasmyth. Examination of the head of Shakespeare proves him to be a representative example of the short-headed type, not of the early British breed, but of the round-headed race which entered Britain in the Bronze period, about 2000 B.C. His brain capacity was more than 1900 cm., as compared with 1477 in an average Englishman. Burns, on the contrary, represents an exceptional example of the long-headed type, with a brain capacity of 1730 cm., at least 200 cm. above the average of his countrymen. His skull displays a close analogy with those found by Prof. Bryce in Arran cairns. He sprang from families settled round the Firth of Clyde, and he is thus a direct descendant of the long-headed people who lived in England and Scotland during the later Neolithic period. We may call Shakespeare a "Celt" in the sense in which this term is used on the Continent, while Burns comes from the western fringe, usually called "Celtic," but really pre-Celtic. "Is it possible," asks Prof. Keith, "that we may explain the extraordinary difference in the working of their brains by the diversity of their racial origin?"

The third All-India Sanitary Conference, held at Lucknow on January 19–27, was attended by delegates from all parts of India and Ceylon, including the Portuguese possessions. Sir Harcourt Butler, in his presidential address, reviewed the work that is being carried on in the study and practice of Indian sanitation, but pointed out that progress is necessarily slow in a land where the habits and prejudices of centuries are arrayed against the sanitary reformer, and where it is impossible to benefit fully by the discoveries of the secrets of disease and mortality until the people are educated to receive and profit by the results of scientific investigation. An introductory address to the opening meeting of the research section was given by Sir Pardey Lukis, Director-General of the Indian Medical Service, who reviewed the present state of knowledge concerning the etiology and prevention of the more prevalent Indian diseases. A number of important papers were read before the conference, and led to interesting discussions on various problems of sanitation and disease, while affording striking evidence as to the energy and thoroughness with which investigations upon such problems are being carried on by the medical officers of our Indian Empire.

At the last meeting of the Entomological Society of London, a communication was received from Mr. J. C. Hawkshaw on the subject of the cocoon spun by the larva of *Lyonetia clerkella*, a small moth of the family Tineidæ. The cocoon is slung like a hammock between silken threads attached to the surface of a leaf. On each side of the area bounded by the supporting threads, a fine web is spun 3 or 4 mm. wide, and very loosely attached to the leaf. If any attempt is made to detach the cocoon with the point of a knife or similar instrument, the cocoon and webs become a shapeless mass, which sticks persistently to the point, and is with difficulty transferred to any other object. Mr. Hawkshaw suggests that this structure serves as a protection against ants, which are constantly seen to be searching the trees inhabited by the Lyonetia. An ant wishing to seize the cocoon would first have to wade through the loose, flattened web, which forms an outwork in the defence, and in this its legs would become hopelessly entangled. If the ant ventured further, its head and antennæ would also become entangled, and would carry the whole away with it. The assailant would probably be quite unable to bring its biting apparatus to bear on the cocoon. A specimen was exhibited in illustration, in which the supporting strands and flanking webs were clearly seen.

THE list of the zoological gardens of the world drawn up by Capt. S. S. Flower, and apparently published at Cairo by the Egyptian Government, has been revised, and a new issue printed, bearing date January, 1914. Inclusive of a few large private collections, such as that of the Duke of Bedford at Woburn Abbey, the number of establishments of this nature known to the compiler is 166.

ACCORDING to an illustrated article by Dr. F. A. Lucas in the January number of the *American Museum Journal*, the late Mr. E. T. Booth, whose well-known collection of British birds is now the property of the Corporation of Brighton, has the best claim to be the founder of the plan of exhibiting in museums groups of animals mounted amid artificial imitations of their natural surroundings. He was followed by Mr. Montagu Brown, then curator of the Leicester Museum, and soon after by the late Dr. R. B. Sharpe, in the Natural History Branch of the British Museum, where a group of coots formed the commencement of the splendid series of exhibits which is now the delight of visitors to the bird gallery. The rise and progress of the practice—especially in America—are fully described in the article, of which a continuation is promised.

PAPERS on various groups of insects from the Philippines and Japan form the greater part of vol. viii., No. 4, of Section D of the *Philippine Journal of Science*. In one of these, dealing with Japanese termites, Mr. Masamitsu Oshima reproves Mr. N. Holmgren for having given new specific names to certain members of that group, previously named by himself in Japanese. Whether technical names proposed in languages unfamiliar in western Europe should be accepted may, perhaps, be open to argument, although it would be somewhat difficult to decide where to draw the line. In papers written in Russian the names of new species and genera are frequently printed in English characters, which at least renders them legible by zoologists of other nationalities. If this was not done in the case of the Japanese papers, the argument for the rejection of the names is strengthened. The names proposed, both by Oshima and Holmgren, were published in 1912, but only the latter appear in the *Zoological Record* for that year, although some of Oshima's publications are quoted in the volumes for 1909 and 1911.

IN an article in *The Indian Forester*, December, 1913, p. 568, Mr. H. M. Glover directs attention to the difficulty of protecting the forests of *Pinus longifolia* in the Panjab from disastrous fires. The accumulation in a few years of fallen needles, dead wood, and old grass render such forests very inflammable; and the fires which are inevitable, owing to the carelessness of the natives, are very fierce, and cause much damage. Mr. Glover advocates, as the result of numerous experiments, the running of a slow fire over limited areas in these forests during winter, when the soil covering is much less inflammable than in the hot weather. Such fires do no harm to pines more than 6 in. in diameter, as stems of this size are covered with a protective thick bark. This method has proved very efficacious, the artificial firing being done during December, January, and February, over areas well under control, from which young growth is absent. Burnt-over sections can be artificially seeded, as seedlings come up in profusion when the refuse has been destroyed.

As a supplement to the paper on the monthly and annual rainfall normals at Indian stations (NATURE, June 26, 1913), the director-general of observatories has recently published a volume containing averages of the monthly and annual number of rainy days at all stations where records for at least five years are available. For some purposes this summary is perhaps even more valuable than the previous one, as it shows whether the monthly amounts were distributed over several days instead of possibly being due to torrential downpours. In the absence of any discussion of the normals it may be interesting to quote the average annual number of rain-days referring to some of the extreme values at stations quoted in the issue of NATURE above-mentioned:—Cherrapunji (Assam), 159·1; Málcompeth (Bombay), 122·3; Launglon (Burma), 145·6; Rújanpur (Panjab), 7·7; Rohri (Bombay), 6·3; Jhatput (Baluchistan), 6·1. The definition given of a rainy day is one on which 0·1 in. or more rain is recorded. This differs materially from the definition for a rainy day in this country, viz., 0·01 in. or more.

THE January number of *Le Radium*, which reached us at the beginning of the present month, contains a valuable collection of tables of radio-active constants brought up to date by M. L. Kolowrat. It is proposed to publish the table annually in order to keep readers supplied with the most trustworthy data. References to the original authorities are given, and the tables are accompanied by a few pages of explanations and remarks.

PART 2 of the *Verhandlungen* of the German Physical Society for 1914 contains a communication from Dr. G. Wiedmann and Prof. W. Hallwachs, of the Technical High School, Dresden, on the part played by the surrounding or absorbed gas in the production of the photo-electric effects exhibited by metals. Although the observations of Prof. Hallwachs and his pupils have all tended to show that the gas plays an essential part in the phenomenon, the idea that the photo-electric process is due to the metal only seems still to persist. With a view of showing how far such an opinion is out of touch with the actual facts the authors have by repeated distillations of potassium got rid of the large amount of hydrogen dissolved in the metal, and have shown that the reduction of the gas is accompanied by a decrease of the photo-electric action. After the fourth distillation the effect was reduced from a current giving 850 mm. deflection to one too small to detect. The result amply confirms the view that the effect is due to the gas absorbed by the metal.

THE inaugural lecture delivered by Dr. W. C. McC. Lewis, the successor of Prof. Donnan in the Brunner chair of physical chemistry at the University of Liverpool, has been issued in pamphlet form, with the title, "Physical Chemistry and Scientific Thought." It is mainly devoted to the significance of research from the purely scientific aspect, especially in connection with some of the problems of physical chemistry.

SINCE Wöhler's first synthesis of a natural organic compound, the chemist has succeeded in building up nearly all the natural compounds from their constituent elements in his laboratory; indeed, the synthesis of the sugars, the polypeptides, the alkaloids, uric acid and its derivatives are some of the greatest triumphs of the chemist. Much of the success in this field is due to the genius of Emil Fischer, and though he has celebrated his sixtieth birthday he shows no signs of relaxing his labours, being now responsible for another great achievement. The importance of the nucleus in the cell needs no emphasis, and therefore the value of the recent work, more particularly of Levene and his collaborators, in America, on its chemical composition has been widely recognised. In brief, the nucleic acids are composed of glucosidic compounds of purine derivatives combined with the carbohydrates to which phosphoric acid is also coupled. The synthesis of such a glucosidic compound of sugar and purine has long been essayed, but it is only now brought to a successful conclusion. Once the principle of the method of making them has been made clear all kinds of purine derivatives can be coupled with the carbohydrates, and when phosphoric acid has been introduced into the molecule the complete synthesis of the nucleic acids will have been achieved.

Engineering for March 13 gives an illustrated account of the new water supply scheme for New York. The actual water supply is derived from the Croton River by impounding this river and its tributaries thus providing 325 millions of gallons a day. The population has increased very rapidly, and the present consumption amounts to more than 500 millions of gallons daily. The additional water supply system, now under construction, is derived from the various watersheds of the Catskill Mountains, from which 800 millions of gallons daily could be obtained. The Esopus watershed is the only one to be developed at present, and has necessitated the construction of a great dam at Olive Bridge. This dam consists of a central masonry portion 1000 ft. long, and rising to a height of 210 ft. above the bed of Esopus Creek. Each end of the masonry is flanked by an earthen wing, which together are about 3600 ft. in length. The greatest thickness at the base is 200 ft., while the top, which is traversed by a roadway, is 26 ft. in width. The up- and down-stream faces are formed by concrete blocks of large dimensions, while the great bulk of the interior masonry is made of cyclopean concrete. Expansion joints are provided, and run through the entire thickness. The roadway on the top of the dam will be 20 ft. higher than the water level, and thus will be free from the action of ice and waves.

THE directors of Messrs. Pathé Frères have agreed to permit the Research Defence Society to hire any nine of their excellent medical and biological films for the modest fee of two guineas. Nine films afford ample illustration for a lecture of an hour's duration, and as a kinema machine can be hired in most large towns, it should prove possible, in view of the generous concession of Messrs. Pathé Frères, to arrange lectures in support of the work of the Research Defence Society at a comparatively small cost. Further particulars of this promising scheme for educating the public in the value of modern medical research can be obtained from the honorary secretary to the society, Mr. Stephen Paget, 21 Ladbroke Square, London, W.

MESSRS. LONGMANS AND CO. announce as in preparation, "Principles of General Physiology," by Prof. W. M. Bayliss. In the volume special attention will be given to reactions in colloidal systems, oxidation, action on surfaces, secretion, excitation, inhibition, nutrition, etc. Messrs. Longmans and Co. also give notice of a new series of monographs on physiology which will be under the editorship of Prof. E. H. Starling. The following volumes are in preparation:— "The Involuntary Nervous System," Dr. W. H. Gaskell; "The Physiology of Reflex Action," Prof. C. S. Sherrington; "The Conduction of the Nervous Impulse," Dr. K. Lucas; "The Physiological Basis of the Action of Drugs," Dr. H. H. Dale; "The Secretion of Urine," Prof. A. R. Cushny; "The Contraction of Voluntary Muscle," Dr. W. M. Fletcher; "The Cerebral Mechanisms of Speech," Dr. F. W. Mott; "The Chemical Mechanisms of Integration in the Animal Body," Prof. E. H. Starling.

OUR ASTRONOMICAL COLUMN.

ELECTRIC WAVES AND THE COMING TOTAL SOLAR ECLIPSE.—It is hoped that the forthcoming total solar eclipse of August 21 will be fully utilised to study the effect of the propagation of electric waves, as this event affords an exceptional and important opportunity of adding to the existing knowledge of the propagation of electric waves in sunlight and in darkness and across the boundaries of illuminated and unilluminated regions. The total eclipse track passes across Greenland, Norway, Sweden, Russia, and Persia to the mouths of the Indus; in Russia the duration of totality will be a little more than two minutes. A circular, distributed by the British Association committee for radio-telegraphic investigation sets forth details of this special kind of investigation and this committee would be greatly aided in the organisation of this piece of research if those possessing the necessary facilities and willing to make observations during the eclipse would communicate with the honorary secretary, Dr. W. Eccles, University College, London, W.C., at the earliest possible date. The committee proposes to prepare and circulate special forms for the collection of statistics of signals and strays, especially within the hemisphere likely to be affected by the eclipse. It will endeavour to make provision for the transmission of special signals at times to be indicated on the forms. It will also offer for the consideration of the authorities controlling stations near the central line a simple programme of work. The discussion of the observations, and the comparison with meteorological data will be carried out by the committee, and digests of the statistics, together with the conclusions drawn from the analysis, will be published in due course.

THE CURIOUS METEORIC DISPLAY OF FEBRUARY 9, 1913.—A brief account was given in NATURE of September 18 last (vol. xcii., p. 87) of what was described as an "extraordinary meteoric display," which was observed over a very extensive line in Canada and America. The display took the form of a procession of meteors, brilliant and coloured, and was compared with a fleet of battleships or airships proceeding at night across the sky. The Journal of the Royal Astronomical Society of Canada for November–December, 1913 (vol. vii., No. 6, pp. 404 and 438) publishes some further information and correspondence relating to this extraordinary display which will be read with great interest. In the first instance, Mr. W. F. Denning communicates an interesting discussion, having gone over the work again, after Prof. Chant's investigation, with the result of obtaining a good general agreement with the latter's conclusions. Even so experienced an observer as Mr. Denning describes the fall as "unique." The further information is supplied by Col. W. R. Winter, of Bermuda, who has been able to collect additional facts since his first report. It shows that the general appearance of the display at Bermuda differed considerably from that observed in Canada, for most of the large leading bodies had disappeared while the number of trailers and groups had greatly increased. Prof. Chant discusses these various opinions and new observations in the article in question.

THE GENERAL DISPLACEMENT OF LINES IN THE SOLAR SPECTRUM.—Some results of a comparison of arc and solar wave-lengths of certain iron lines appear in Bulletin No. xxxvi. of the Kodaikanal Observatory by which Mr. Evershed has been led to a new interpretation of the general displacement of lines in the solar spectrum towards the red. The completion of the electric installation has enabled use of the arc to obtain spectra of the sun and laboratory source of light on the same plate, thus permitting more accurate determination of absolute and relative shifts of the lines in the solar spectrum. Some of the plates have been measured by the positive on negative method recently noted in this column. Mr. Evershed's determination of the difference between sun and arc agree, in the main, very well with the figures which MM. Fabry and Buisson have obtained by the interference method. The pressure explanation of the origin of the shifts is now found to be quite incompatible with the observations in three different directions: (1) King's low-level lines show *least* shifts in the sun; (2) the lines showing greatest shifts under pressure in the laboratory show least shift in the sun; and (3) the lines in the red do not show the greatly increased shifts they would be expected to if Duffield's exponential law were followed. It is found that lines in the red show the least shifts, and that the strong (high-level lines) are most affected. These two facts receive adequate explanation on the supposition that in the higher levels there is a movement of descent with a negative acceleration. The motion for the strong lines amounts to 0·93 km./sec., while for the weak lines it is less than 0·3 km./sec. The director is to be congratulated on the early advantage he has taken of the increased facilities afforded by the completed electric installation.

ORIGIN OF PLANETARY SURFACE FEATURES.—M. Emile Belot has communicated to the French Academy of Sciences a tentative theory of the mode of formation of the external features of some planetary bodies, more especially those of the earth (*Comptes rendus*, vol. clviii., p. 647). Whilst one does not feel by any means compelled to accept all the suggestions there put forward, the paper is nevertheless intensely interesting, and contains some highly original ideas regarding the development of the heart-shaped figure of the earth and the formation of land areas based on the hypothesis of a relative movement of translation of the earth (also the moon and Mars, which are regarded as resembling the earth) in the primitive nebula, the movement being in the direction of the axis of rotation from south to north. M. Belot regards the main land features as cognate with water. He supposes, indeed, that they were formed by the deposition of material carried by surface torroidal currents flowing away from the south pole, completing a stupendous circulation generated by the resistance offered by the nebula to the movement of translation. The vertical cool descending current in the Antarctic region marked that as the site of the condensation of the water of the ocean.

SMOKE ABATEMENT IN EUROPE AND AMERICA.

THE movement for lessening the evils of smoke, both factory and domestic, is extending and increasing in weight and importance. In our own country, the health authorities of sixteen cities have commenced to make accurate observations upon the extent and character of the soot- and dust-fall, by a standard method and apparatus.

Classes for the instruction of stokers and engineers in the scientific principles of combustion are now included in the curriculum of the majority of the larger technical schools and institutes; and a movement is in progress to obtain higher wages and a better status for the men who have passed satisfactorily through these courses of training, and have obtained a certificate of efficiency. Glasgow has made most progress in this direction, and has also carried on for several winters a series of popular lectures, designed to bring home to the general public the losses and evils arising from smoke, and the best methods of minimising these, both in the works and in the home. The classes and lectures have been carried on in Glasgow, by the West of Scotland Branch of the Smoke Abatement League; in Manchester, Liverpool, and other towns and cities, the classes are run by the local education authorities.

In Germany, the Hamburg "Verein für Feuerungsbetrieb und Rauchbekämpfung" continues to flourish, and can show a membership of nearly 500 members, the majority of whom own boilers or other heating appliances, and are thus large users of fuel. The officers of the Verein are now directing their attention to the emission of smoke from steamers lying in the port of Hamburg, and are seeking to extend the benefits of their system of supervision to the Mercantile Marine.

In America, the most notable event of the past twelve months has been the publication by the Mellon

Institute of Industrial Research in the University of Pittsburg of a series of bulletins dealing with the results of the inquiry into the black smoke problem in that district of the U.S.A. Five bulletins have been issued so far: No. 1 deals with the "Outline of the Investigation," No. 2 is a "Bibliography," No. 3 discusses the "Psychological Aspects of the Problem," No. 4 deals with the "Economic Cost of the Smoke-Nuisance in Pittsburg," and No. 5 with the "Meteorological Aspect of the Smoke Problem."

Bulletin No. 4 contains the following summary of the losses annually incurred in Pittsburg, as a result of the damage and dirt produced by smoke:—

	£
(1) Cost to the smoke-maker, by imperfect combustion	304,150
(2) Cost to the individual: laundry and dry-cleaning bills	450,000
(3) Cost to the householder: painting, cleaning, and decorating	466,400
(4) Cost to the proprietors of wholesale and retail stores: cleaning, lighting, depreciation of stock	735,000
(5) Cost to the owners of office buildings, hotels, and hospitals	43,400
Total	£1,998,950

This estimate, it must be noted, covers the losses per annum in one American city alone, the population of which at the present time is about 350,000. Calculated for each head of the population, the loss is therefore about 5*l.* 13*s.* per annum.

Assuming that London is only suffering pecuniary losses from the smoke evil to one-half the extent of Pittsburg, the total will represent a loss of well over ten million pounds per annum, or more than double the estimate given by the Hon. Rollo Russell, in a paper read at the Building Trades Exhibition and Conference, held in London in 1899.

J. B. C. K.

THE AFRICAN MAMMAL FAUNA.

FROM a zoological point of view the year which has just come to a close will be noteworthy on account of the extraordinary number of new specific and subspecific names applied to members of the African mammal fauna. In the case of the larger forms a great proportion of these names have been proposed as the result of the detailed examination of the vast series of East African mammals collected during the Roosevelt expedition, by Mr. E. Heller, who, in various issues of the Smithsonian Miscellaneous Collections, has described as new a number of local races of monkeys, antelopes, and Carnivora. To some of these reference has been already made in NATURE, with mention of the very slight differences by which many of the new races are distinguished. The same naturalist has also, during 1912 and 1913, made several well-known antelopes the types of new genera, separating, for instance, the lesser kudu as Ammelaphus, and Hunter's hartebeest as Beatragus, the latter term being formed by combining "B.E.A.," the initials of British East Africa, with the Greek *τράγος*—a combination which would have made the classically educated naturalists of a previous generation recoil with horror.

Local races of the arui or North African wild sheep have been described in "Novitates Zoologicæ," by the Hon. Walter Rothschild, who has also, in the December issue of the *Ann. Mag. Nat. Hist.*, given names to various local races of antelopes, among these being the Congo representative of the giant eland, which appears to be the largest form of that species. A new race of the ordinary eland, as well as various monkeys, have been named by Dr. P. Matschie, respectively in the *Sitzber. Ges. nat. Freunde* and the *Revue Zool. Africaine*; while several local forms of antelopes have received new names from Mr. E. Schwarz in the *Ann. Mag. Nat. Hist.* Nor does this exhaust the list of antelopes, as Mr. Gilbert Blaine, in the journal last cited, has named a new gazelle from Erythrœa, as well as two races of reedbucks.

Among the smaller mammals particular interest attaches to the description of a second species of the remarkable insectivorous genus Massoutiera from the Algerian Sahara, by Mr. O. Thomas, in vol. xx. of the "Novitates"; while various new African bats and shrews have been named by the same writer in two issues of the *Ann. Mag. Nat. Hist.* By far the largest number of additions to the list of African Micromammalia has, however, been made by Mr. Austen Roberts, who, in vol. iv., part 2, of the Annals of the Transvaal Museum, has described as new no fewer than twenty-eight species and subspecies from the Transvaal and neighbouring South African States.

Although many of the races to which separate names have been applied during the year are undoubtedly worthy of recognition and distinction, those based on minute and unimportant colour-differences make the thoughtful naturalist wonder where the splitting process is to end, and what advantage accrues to science when it is carried to the excess which is now in vogue.

R. L.

THE INSTITUTE OF METALS.

WE have received a copy of the tenth volume of the Journal of the Institute of Metals, containing, principally, an account of the papers read and discussions at the autumn meeting of the institute, held at Ghent in September last. The volume reflects the flourishing state of the institute, which has now held its first meeting abroad, and with marked success.

The most important feature of the volume is the second report to the corrosion committee, in which Dr. Bengough and Mr. Jones, of Liverpool University, give an account of their work on this subject. This has included laboratory experiments and also trials with an experimental condenser erected with the funds collected by the corrosion committee. This somewhat costly form of investigation has, however, fully justified itself, and its continuance is assured by the further financial support received from some of those most interested in condenser-tube corrosion. The report constitutes an important forward step in our knowledge of the corrosion of brass by the process of "de-zincification." It is shown that in a simple 70/30 brass this occurs normally in contact with sea-water, particularly if the temperature is raised to the vicinity of 40° C. A white zinc-salt, of the nature of a basic chloride, is formed, and acts as a species of catalytic agent, leading to the continued solution of zinc with constant re-formation of the basic chloride. Muntz metal is found much inferior to brass in this connection, but a brass containing 1 per cent. of tin, or, better still, 2 per cent. of lead, is found to resist this form of corrosion far better than a pure zinc-copper alloy. A remarkable result brought out by the report is the negligible influence exerted on dezincification by local electric cells, such as those formed by adherent particles of other metals or of carbon.

Among the other papers may be mentioned a further contribution to the theory of an amorphous intercrystalline cement, by Dr. Rosenhain and Mr. D.

Ewen, which deals with the nature and causes of the brittleness of even the purest metals at temperatures near their melting points. Mr. H. Garland, of Cairo, contributes a paper on the micro-structure of ancient Egyptian metal specimens, showing that the metastable structure of cored solid solutions has persisted through many thousands of years. Prof. Hoyt deals with the constitution of the "kalchoids," by which repellent name he denotes the alloys of zinc, tin, and copper, while Prof. Guertler, of Berlin, contributes a discussion of the relation between alloy constitution and specific volume. All the papers attain a very high standard of scientific and technical interest.

HYDROLOGY IN THE PACIFIC.[1]

IT is a "far cry" to the Sandwich Islands, and equally a "far cry" to the days of Captain Cook with his intrepid crew, pioneers in the exploration of Polynesia. Many changes have taken place since the black day in 1778 when the renowned navigator came to his tragic end on the snowy sand beach of Hawaii. The modern traveller who wanders so far will find the Hawaii of to-day a fully civilised community, the streets of the principal town of which, Honolulu, besides being laid with tramways and electric mains, are so covered with a network of telephone wires as to give the impression of a huge spider's web amid the palm-trees.

The Sandwich or Hawaiian, Islands are eight in number, forming a chain about 400 miles long, distant some 2,000 miles from the North American continent and from the United States, of which they constitute a territory. The principal unit is Hawaii, which gives its name to the group, and is in area more than double any of the others. The capital lies on the island of Oahu. The industry is chiefly agricultural. Practically the whole of the exports—99 per cent.—are products of the soil (rice, sugar, taro, etc.), and of these 93 per cent. are either absolutely dependent on irrigation for growth, or require the application of water at some period or other to stimulate their development, and produce the most satisfactory yield. Such being the case, the administration and conservation of the water resources of the islands are matters of obvious and fundamental importance, in regard to which the United States Government shows no sign of neglecting its responsibilities. The volume just published is an account of the investigations made during the period 1909–11 into the conditions and factors influencing the flow and economic development of the surface waters. It is replete with statistical data and full of strange names of streams and places, the pronunciation of which (Awaawapuhi, Puuwaawaa, Kukuihaele, for instance), though no doubt musical enough when correctly rendered, seems to be beset with difficulty for the uninitiated. B. C.

THE RESEARCH CHEMIST AND THE TEXTILE INDUSTRY.[2]

THE textile industry of this country shows a gross value amounting to the considerable total of 333,000,000*l.*; materials to the value of 235,000,000*l.* were used in their manufacture; and 1,253,000 persons were employed in their manipulation. The power used amounted to 1,987,000 h.p., and 77 per cent. of the firms engaged in their work made a return that they had used during the same period 8,137,000*l.* worth of coal. These figures indicate that there must be under modern conditions an ever-increasing call for research chemists in this industry. If the standard that one chemist is required for every 2000 persons employed in the textile industry were set up, there would be room for no fewer than 620 highly trained chemists, who would each be dealing with an "average gross output" of the value of more than 500,000*l.* per annum.

When it is remembered that a Continental combine in the aniline dye industry employs more than 600 chemists, the above estimate of ultimate requirements cannot be considered unreasonable. The effect of this army of chemists working in the interests of the textile industry would naturally lead to astonishing developments and to considerable improvements in detail.

The student who enters a works on the research side, after having received a university education (or having equivalent qualifications), will, undoubtedly, possess a knowledge of chemistry which will rank as an immediate asset. In a way, the college training will also have prepared him for actual working conditions by indicating their nature.

In addition to this knowledge of theory, the student will make immediate use of any experience he may have gained in ordinary analytical operations. It will often be necessary to devise new methods of analysis, or, at least, modify old ones, before they can be utilised in industrial investigation. A knowledge of the principles which underlie such work is, therefore, a very necessary equipment for the young investigator. This also involves a training which has a special value to those entering this, and most other, industries. In many cases, work will rest on the borderland of industrial research, where the actual analysis of certain products can replace actual experiment in very few cases. It is the latter which counts. The former is generally of secondary value.

The research chemist will probably enter the works at an early age. If he has finished his college course at twenty, a year or two of teaching work will do no harm. It will consolidate his knowledge of theory under the stress of imparting it to others. Better still, if it is possible to determine, at that stage, the direction of his future work, he may engage in a post-graduate course of research. The actual time of coming in contact with works conditions should not be delayed beyond the age of twenty-two years, for the mind must be capable of readily adjusting itself to industrial conditions, which are naturally different from those surrounding the student in a college laboratory.

The introduction of a time factor in its relation to cost of production will alone have a great influence. Work in the factory may be practically continuous in its operation. The young chemist will, therefore, quickly realise that he has to deal with entirely new conditions. These will at once claim his interest by reason of their novelty and importance. He will soon be engaged in the attempt to control, or modify, operations proceeding on a scale possibly measured in tons, or thousands of yards.

The raw material will enter at one end of the factory. At the other end, it will leave in a more or less "finished" state. This operation may, in some cases, take months to complete, during which time the material may be subjected to innumerable processes which may possibly modify both its physical and chemical properties. The chemist will endeavour to understand, and so control, these operations that, during transit through the works, material may receive a minimum of treatment to produce a maximum effect; for this generally means satisfactory working conditions, and low cost of production.

[1] "Water Resources of Hawaii, 1909–11." Prepared under the direction of M. O. Leighton by W. F. Martin and C. H. Pierce. Pp. 552+11 plates +3 maps. (Washington: Government Printing Office, 1913.)

[2] From lectures delivered before the Institute of Chemistry, October and November, 1913, by W. P. Dreaper.

What general effect can the successful investigator have on the methods and processes employed in work of this nature? He must aim at a position under which determining methods of working are being constantly modified in detail; or even in nature. Under the most successful conditions he may, in time, find himself working three years in advance of those who are not taking full advantage of modern methods of investigation. It is difficult for an industrial chemist to hide from his experienced rivals a process or method which can be detected in the finished product by ordinary, or even special, means. Many improvements are, however, of such a nature that they cannot be detected in this way, and then the above condition may be found to apply. In most cases this standard is a reasonable one to aim at. More than this can scarcely be expected, unless the Patent Law comes in to protect ideas and methods for a longer period. When this is realised, there is obviously no finality to work of this nature, and as a result a condition of continual change will probably be set up in the factory.

It is surprising to what an extent secret working has in some cases secured a monopoly. Especially is this so, when the effect of a process, or use of a machine is not self-evident or easily traced in the finished article. Under such conditions, and more particularly where an industry has not adopted a scientific control, a certain sequence of operations has been known to remain the monopoly of a firm, or a limited number of firms, over many years—as witness the Turkey Red industry.

Even where a close examination of the finished product might suggest, to the experienced investigator, the method of treatment employed, its presence is often overlooked or unsuspected because of difficulties in the way of identification or analysis. A slight and inexpensive change in manufacture may add 10 per cent. to the apparent value of a textile material. What this means on a large output can easily be imagined, as the ordinary net profit on manufacture may be somewhere between 20 and 35 per cent.

The research chemist is, therefore, constantly trying to improve or devise methods of investigation which will enable him to keep in touch with the work of those who, for the time being, may be regarded as his competitors; and the methods utilised to this end are based more often upon personal experience than published results. Such processes generally deal with the recognition of certain physical or chemical changes which occur when the material is subjected to tests corresponding to those in actual practice. Owing to their value to the investigator, such methods are not generally disclosed. Work in this direction, or modifications in accepted processes of analysis, and in the proper interpretation of results, are often carefully guarded, until through some change in procedure, they no longer retain their original value. Many such examples will occur to the technical chemist.

The aim of the chemist in this respect is to obtain some clue of a physical or chemical nature which will suggest to the experienced investigator the nature of superior working methods. Such methods of obtaining an insight into hitherto unknown processes or applications are of considerable value. They can only be successfully used by the investigator who has a practical knowledge of manufacture in addition to an ordinary laboratory experience. Thus, to the industrial research chemist, analysis may have a different meaning to what it has to the general consulting chemist. It is a means to an end which possibly may be the discovery of the nature of a process. Analysis is also utilised to obtain the correct working conditions of a new process, or the better control of an old one.

It will be gathered from these remarks that procedure must in many cases be empirical in its nature.

The research chemist often has to watch ordinary manufacturing operations over extended periods before any plan of control or improvement can be devised. Light is sometimes thrown upon such a position by the occurrence of irregular results in the daily output, or a systematic examination of the effects produced by accidental, or predetermined, variations in working conditions. Many problems have been successfully investigated by such means. Such variations, as they occur in everyday practice, may often lead to important improvements, or even suggest new processes. Thus, the research chemist will soon realise that his right place is in the works. He will use the laboratory mainly to follow up ideas in detail.

The introduction of new methods naturally calls for an immediate re-examination of the conditions of working of existing processes. This may often secure to them an extended lease of life, as in the case of the collodion method of preparing artificial silk. In these days of costly apparatus for plant, this factor must not be lost sight of. It is the first point to consider when the chemist finds he has to deal with, and equal, the results obtained, by the introduction of a more efficient process, leading to the production of a better or cheaper product.

The successful worker must, however, go further than this. Experience indicates that important results have generally been obtained by striking out boldly in a new direction. The risk connected with such pioneer work can always be minimised by working on a moderate scale, and making sure of the details of every step as it occurs in a natural sequence. With long experience, it is sometimes possible to experiment at once on a large scale with a reasonable chance of success, but this course should never be followed by the beginner. Such conditions are comparatively rare, and generally governed by some secondary consideration, such as the prohibitive cost of new apparatus, as compared with the utilisation of that already available in the works.

In industrial research, it is sometimes more important to know what not to do than the reverse. This restraining influence must be developed equally with originality. In this, the worker will naturally be guided by instinct, which may be defined as the tempering of past experience by an untiring caution.

Once more, the young chemist may be urged to spend most of his time in the works, only working in the laboratory when some work requires systematic investigation. Many manufacturers have objected to this procedure in the past, but with tact, such opposition, where it still exists, can generally be overcome. The industrial chemist who remains in his laboratory will be hopelessly left behind in the race for progress.

It is impossible to say how far the chemist should experiment in the laboratory, or when he must carry out the necessary investigation in the works itself. In the latter case, it is well to leave such labour as does not entail exact measurement in the hands of the workman. The chemist must, however, *know how to carry on such work*, and in cases of difficulty, be able to do so under the eyes of the workman. This is sometimes a rather trying experience to the novice, but it must be faced.

Be careful, when starting experimental works, and reasonably certain that all data which can be obtained on a laboratory scale are already secured. Only then should the establishment of experimental works be attempted. Much can be done in the way of experimental plant, etc., in the laboratory with 100*l*. An experimental works will probably absorb anything between 3000*l.* and 10,000*l.* before any important results or improvements can be obtained.

It sometimes happens that preliminary operations of a seemingly innocent nature induce material changes which cause endless difficulties in subsequent treatment. These disturbing causes will be entirely overlooked if the chemist does not carry his investigations back to the raw material and examine processes on the broadest lines.

In the process of mercerising the fibre must be kept under a condition of strain during at least one part of the process; and a long staple cotton (Egyptian) must be used if the treatment is to have its maximum effect. The mere chemical operation of mercerising was, in itself, ineffective (Figs. 1 and 2).

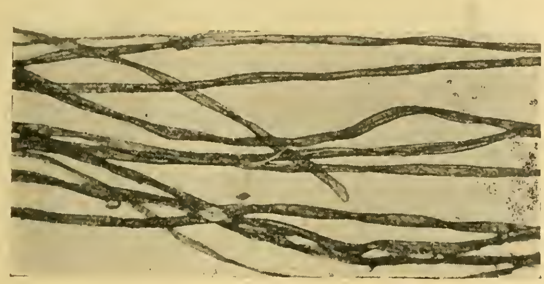

FIG. 1.—Cotton fibres (× 100).

Thus, it is evident that the modern chemist must be prepared to carry his investigation to the extreme limits of experiment, or satisfactory results will not be obtained. Also that he must extend his work beyond the realm of chemistry proper. A more general knowledge and scheme of working are necessary if the laboratory is not to remain a mere adjunct to the engineering department. The term, "chemical technologist," is one which possibly best describes the qualifications of the industrial investigator, and the knowledge he must possess.

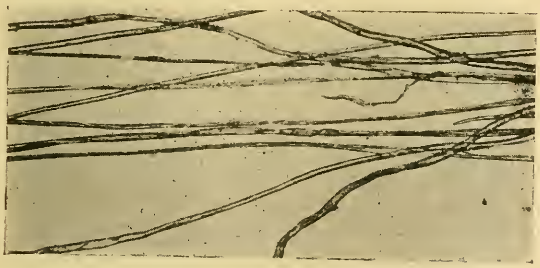

FIG. 2.—Cotton fibres after mercerising under tension (× 100).

When the student considers such processes, he will realise that the difficulties and nature of modern industrial research are closely concerned with detail. This is always so. Many problems of similar importance undoubtedly still exist in the textile industry, but these will be solved only by the trained investigator who attends to this essential point.

Thus, success is often closely associated with the art of carrying existing processes a stage further. It is with the careful working out of additional detail that it is associated.

In numberless cases, progress is only secured by following up a seemingly unimportant point. This being so, the importance of a training, be it self-inflicted or otherwise, which qualifies a man to deal with such problems is evident. In its absence, progress can only be realised by the more slowly working aid of rule-of-thumb.

The presence of this factor has given the rule-of-thumb man great power in the past, for he has at his command a wonderfully accurate instrument in the trained eye. The chemist with all his apparatus is in some cases no match for him.

The investigator, sooner or later, realises the essential value of empirical methods, and if he is wise lets the worker know that he does so. In this way, the chemist gains the worker's confidence, and the latter more clearly realises the true aim of research. Once this position is established, the workman will naturally direct attention to any variations in working which may occur, or make suggestions of distinct value. The workman has a great advantage. His mind is continuously concentrated on one operation. Thus, it often happens that only by a careful study of deviations from the normal will the research chemist be able to report progress. His aim is to explain and control, the workman's to manipulate.

Facts which are but "curiosities" to the workman, and have remained so for many years in some cases, must be carefully investigated in detail by the chemist. They often represent the starting point for improvement—a first aid to progress, when all other means have failed. Time given to such investigation is never lost, for experience in the ways of processes is a commanding asset to the industrial chemist.

Where operations are conducted on a large scale there is a greater chance of recognising such conditions. An improvement when applied on a larger scale has also a greater value. It is, therefore, better for the young chemist to get into a large works; unless he is compelled to enter a single department, in which case the greater freedom in a small works may be more valuable in spite of restricted output.

Attention may be directed to a list of the probable actions which may be involved during dyeing operations, which I advanced some time ago.

(1) A solution state of the dye within certain limits of aggregation as determined by the laws of solution.

(2) A fibre state corresponding to this state of aggregation and of a permeable nature.

(3) Localisation of dyestuff within the fibre area through surface concentration effects.

(4) Localisation of salts, acids, etc. (assistants), within the fibre area from the same cause.

(5) The direct entrance of dye aggregates by molecular migration, with subsequent reformation of aggregates within the fibre area.

(6) De-solution, due to surface concentration effects ("salting out"), or secondary attraction, between the fibre substance and the dyes.

(7) Primary or chemical action, which may play some part at this stage, and may even in some cases take the place of, or cause, de-solution phenomena.

(8) De-solution effects in the case of basic dyes, which may lead to alteration in constitution, and the production of basic salts in a state of high molecular aggregation (insoluble) within the fibre area.

In recent years, Perrin has suggested that the action of dyeing is a purely electrical phenomena, and this suggestion has been followed up in some detail by Gee and Harrison in this country.

It is only in certain cases that the chemist has a voice in the purchase of textile fibres, when certain physical or even chemical factors are recognised as being in question.

The need for such supervision may be seen in the agitation which has been actively carried on by trade associations and others concerning the methods used in South Africa in the dipping of sheep.

For some reason best known to the authorities, a sheep dip is officially recommended which consists of a mixture of slaked lime and caustic soda. The effect of this on the wool itself is sufficiently injurious, for the selling price of South African wool to be materially affected, and endless trouble introduced in subsequent manufacturing processes.

It is said that the breaking strength tests show a loss of 18 per cent. in the treated wool. Although wool buyers and English chambers of commerce have protested since 1899 against this treatment, it is still carried on, and the directions, issued in the *Government Journal of the Union of South Africa* so recently as March, 1913, still recommend its use, and give particulars of its preparation.

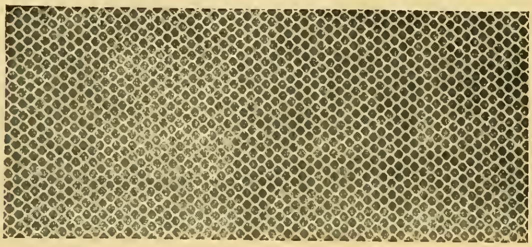

FIG. .—Artificial cellulos fabric (natural size).

This example must be the only one which can be discussed on the present occasion. Many of the methods used to determine certain differences in the nature of raw materials which count in the subsequent manufacture, as they have been noted, or even controlled, by chemists, are considered to be of a more or less secret nature.

Although we are not directly concerned with the rebleaching of goods, the use of electrolytic bleaching liquors may be strongly recommended for the laundry trade. As the sodium hypochlorite leaves the electrolyser it gives better bleaching with weak solutions than the older bleaching liquor does with strong ones. Two of the best-known types of electrolysers are those of Kellner, and that sold by Messrs. Mather and Platt. In the modern type, the original salt or brine solution passes in a serpentine course between the platinum or carbon electrodes. The salt employed in the solution is never entirely converted on grounds of economy, and care has to be taken to adjust the cost of current to that of the salt to secure economical results. Under present conditions, the cost of electrical energy must be low, but in view of the many advantages which the use of the sodium salt gives the bleacher, the new process will obviously be put to more extended use.

FIG. 4.—Artificial silk thread (×80).

It is a mistake, however, to imagine that the chemist's work in the textile industry is chiefly concerned with the adulteration of material and supplying the public with something which is not what it appears to be. Such work is mainly constructive, and its influence has been for good. Extraordinary results have been achieved in the last twenty years in the direction of actual improvements in manufacture as well as in the cheapening of production.

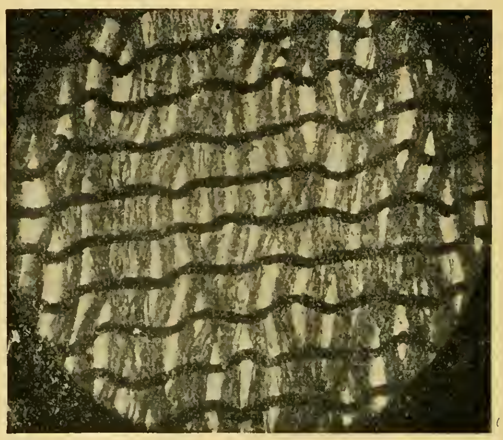

FIG. 5.—Crêpe de Chine, satisfactory finish (×30).

The manufacture of artificial fabrics direct from a solution of cellulose is a case in point (see Fig. 3), or that of artificial silk as shown in Fig. 4.

The use made of the microscope is seen in Figs. 5 and 6, where the difference in certain finishing operations is clearly disclosed and explained.

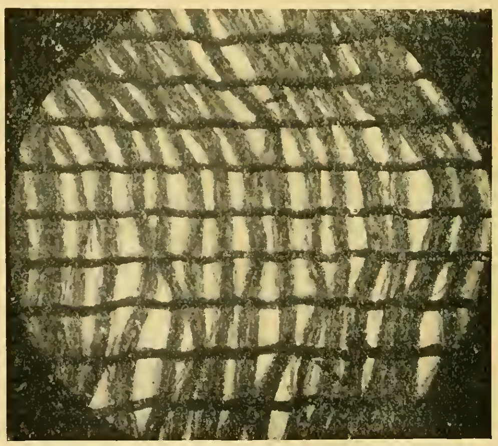

FIG. 6.—Same material, unsatisfactory finish (×30).

It will be gathered from the remarks made generally in these lectures that the influence of moisture, in its relation to the many operations of finishing adopted in this industry, is paramount. It is probably the most important influence which the investigator has to consider. The presence of moisture in a fibre gives rise to many conditions, which seem to indicate that it is present in more than one condition. This materially adds to the difficulty in determining its true influence. The fact that all the fibres take up moisture, and that this influences them in different ways, is one of the most perplexing problems met with in this industry. It will probably be many years before this matter is properly understood. or explained scientifically; but when this is achieved, light will undoubtedly be thrown on many phenomena which are so obscure to-day; and which, under present conditions, can only be dealt with on empirical lines.

The relative position of the chemist and engineer in the works has given rise to discussion in the past, and still shows signs of not being altogether understood.

The opposition to the chemist which is said to exist in some quarters has probably been much over-estimated. In the majority of cases the chemist obtains all the necessary aid he may require from the engineering department. As a matter of fact, the engineer always seems interested in the chemist's work. This is due, no doubt, to the different method of attack adopted by the latter, which, in itself, fully justifies the presence of the chemist in any works.

Under normal conditions the engineer frankly helps the chemist in his experimental work, and this aid is of real service in many ways. Quite apart from his previous training, the chemist will pick up a fair knowledge on the engineering side in the works, which will be particularly useful in cases where he subsequently acts as manager of a department, or even of the works itself

The chemist should be just as anxious to make friends with the engineer as with the heads of other departments; and the best way to gain experience and knowledge in this direction is to keep in touch with any new experimental plant which may be in course of erection.

In some cases, work will develop in directions which are not naturally covered by any existing department. If the operations involved are complicated, it may be better for the process to remain under his direct management or control. In this case, one or more experimental departments may, in time, be associated with the laboratory.

It is then necessary to borrow men from the engineering department, and to direct their operations. When this happens, the work of the chemist becomes still more general in its nature, and additional experience is gained in the management of men and processes.

Where experimental work is rapidly translated into full-scale operations under normal conditions, the control will pass to one of the works departments. This should be encouraged, for the chemist is then more free to continue research in any other directions which may present themselves. But he must always be ready, and able, to resume temporary control if things go wrong, or where further developments are in progress.

The evidence that a merely chemical training is insufficient is fast accumulating, and may be emphasised. The chemist may, for weeks, be working in directions which are physical or even mechanical in their nature rather than chemical. The important point is that *his method of attack is based on a past training in chemistry*; and that, because of this, it will be different from that adopted by the engineer. In this its value rests. This is the point I have tried to emphasise in these lectures. Also that success in almost every case depends upon attention to detail. Thus, an inferior mind may sometimes succeed when once a main idea has been grasped. These are the points I would especially bring to the notice of the young chemist who is entering the textile industry on the research side.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The council of the University has appointed Prof. Charles Lapworth emeritus professor of geology in recognition of his services during his occupation of the chair of geology. The Senate recently signalised his retirement by the presentation of an address and a gift of plate, and on March 11 another presentation was made to him by a large number of his old students. Prof. Boulton was in the chair, and Dr. Walcot Gibson, who spoke on behalf of the old students, gave happy expression to the affectionate esteem in which Prof. Lapworth is held by all who have had the good fortune to come under his influence.

CAMBRIDGE.—The Observatory Syndicate has appointed Prof. A. S. Eddington, Plumian Professor of Astronomy, to be director of the observatory.

Mr. A. V. Hill has been appointed to the Humphrey Owen Jones Lectureship in Physical Chemistry.

DR. PRAFULLA CHANDRA RÂY has been appointed to the Sir Taraknath Palit professorship of chemistry in the Presidency College, Calcutta, and Mr. C. V. Raman to the Sir Taraknath Palit professorship of physics in the same institution.

IT is announced in the *London University Gazette* that a course of eight lectures on the rate of the blood-flow in man in health and disease will be given in the physiological laboratory of the University, South Kensington, by Prof. G. N. Stewart, professor of experimental medicine, Western Reserve University, Cleveland, U.S.A., at 5 p.m., on Tuesdays, from May 5 to June 23 next. The lectures are addressed to advanced students of the University and to others interested in the subject. Admission is free, without ticket.

AN article on careers for university men, by Mr. H. A. Roberts, the secretary of the Appointments Board in connection with the University of Cambridge, contributed to the *Cambridge Magazine* in 1912, has been issued in pamphlet form by Messrs. Bowes and Bowes, of Cambridge, at the price of 6*d*. net. The account given of the work of the Appointments Board at Cambridge shows the usefulness of such an agency in bringing together employers of labour and university men who desire appointments. Graduates will find invaluable the information here brought together as to public posts open to suitable university men, and the facts as to the salaries to be expected at the beginning of a career should save much disillusionment later.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 12.—Sir William Crookes, president, in the chair.—Sir James **Stirling**: Note on a functional equation employed by Sir George Stokes.—Prof. J. C. **McLennan** and A. R. **McLeod**: The mercury green line $\lambda=5461$ as resolved by glass and quartz Lummer plates and on its Zeeman components.—H. **Hartley**: The electrical condition of a gold surface during the absorption of gases and their catalytic combustion. At the suggestion of Prof. W. A. Bone, the author has carried out experiments on the electrical conditions of a gold surface during its absorption of hydrogen, carbon monoxide, and oxygen, respectively, at temperatures between 300° and 400°, in order to establish certain data relative to surface combustion phenomena. The results have proved (1) that the metal acquires a *negative* charge during the catalytic combustion of gases in contact with it (thus confirming previous unpublished observations by Bone and Makower), which effect is probably antecedent to the actual combustion, and primarily due to "occlusion" phenomena; (2) that the metal becomes *negatively* charged (0·5 to 1·5 volts) during the occlusion of the combustible gas (hydrogen or carbon monoxide), and *positively* charged (0·8 volt) during the occlusion of oxygen; and (3) that such electrical effects are probably due to occluded gas which is *leaving* (rather than *entering*) the surface. The experiments indirectly lend support to the view that the well-known electronic emission from incandescent solids is probably dependent upon the occlusion of gas.—J. H. **Mackie**: The diffusion of electrons through a slit.—Dr. A. **Holt**: The rate of solution of hydrogen by palladium. The rate of solution of hydrogen at constant (atmospheric) pressure by palladium in the form of black, thin and thick foil has been examined. The rate curves in the case of palladium black are simple and of continuous curvature, but for the foil a more or less pronounced discontinuity of curvature is always observed. The discontinuity is accounted for by considering that the gas is dissolved in two different forms of the metal, the rate of solution being different in the two forms. Palladium black is believed to consist almost wholly of one form, and hence gives a simple rate curve, whilst the foil (which is mainly crystalline) contains both varieties of metal, and so gives two rates, the first rate passing into the second when solution in both forms becomes equally rapid.—Dr. R. A. **Houstoun**: The dispersion of a light pulse by a prism. A light pulse of a form giving the Wien energy distribution is incident on a prism, and expressions are derived (1) for the disturbance in the region immediately behind the prism where the different colours overlap; and (2) for the disturbance in the focal plane of the telescope. The first expression holds only for a particular law of dispersion, but the second is for any law of dispersion. They are both in accordance with results obtained by Lord Rayleigh by considerations of stationary phase and hydrodynamical analogy, but they go further. For example, it is definitely stated how the amplitude varies in the front and rear of and throughout the train of waves given rise to by the pulse in the different parts of the spectrum.

Geological Society, February 20.—Dr. Aubrey Strahan, president, in the chair.—Annual General Meeting.—President's address: As his main subject, the president referred to that part of the work of George Darwin and Wallace which bore on the history and age of the earth, and commented on the vagueness of the evidence on which estimates of the rapidity of denudation in past times are founded. Before attempting estimates of primeval time, it should be shown that some degree of precision is attainable in calculating the amount of denudation effected in post-Glacial times, and the time required to effect it. It is now possible to distinguish the features in the landscape which are due to post-Glacial erosion. River-gorges, dissected plateaus, fans, and deltas of gravel are presented for consideration. In some there seems to be a possibility of estimating the bulk of the material which has been moved, and the rapidity with which the transporting agents are working. Fans spread on the flat bottoms of valleys by tributary streams, or deltas formed in lakes, are of common occurrence. In all cases it would be of value to determine a relation between three factors, namely, the size of the fan or delta, the discharge of the stream, and the character of the ground from which the material was derived. Dammed-up rivers give opportunities for observing the amount of material transported by rolling. The distances over which rivers are now transporting material should be ascertainable by observing the composition of recent alluvial deposits. Few roll gravel directly into the sea, for the gradients in the lower parts of their courses are too low for transportation and favour deposition. An investigation on English rivers has been proceeding for some years, with the object of ascertaining (1) the discharge, (2) the suspended and dissolved impurities, (3) the rainfall, (4) the areas of the basins, and (5) the character of the rocks. The rivers suitable for the investigation are limited to those with a single definite mouth. Fen-rivers have a number of outlets, and cannot be gauged. The amount of material now being rolled by the Exe, for example, is determined from records of dredgings. Rainfall is dealt with by the British Rainfall Organisation, as also the methods of eliminating the error in calculating average rainfall, due to the preponderance of rain-gauges in the lower ground. It was concluded that, although in this country a hydrographic survey may not be essential on the ground of utility, yet more systematic observations on the work of denudation are within the reach of geologists.

February 25.—Dr. A. Smith Woodward, president, in the chair.—Rachel W. **McRobert**: Acid and intermediate intrusions and associated ash-necks in the neighbourhood of Melrose (Roxburghshire). The age usually assigned to the igneous intrusions is a late period in the history of the "plateau-eruptions" of Calciferous Sandstone times. The igneous rocks occur as laccolites and sills, as dykes, and in volcanic necks. The chief rock-types present in the area are porphyritic and non-porphyritic sanidine-trachytes, quartz-trachytes, riebeckite-felsites, quartz-porphyries, basalts, and volcanic agglomerates. The salient features of the suite of rocks described are the high content of alkalies, and the presence of soda-bearing minerals such as riebeckite, ægirine-augite, primary albite, and soda-orthoclase. Nepheline was found to be absent from most of the rocks.—A. **Vaughan**: Correlation of Dinantian and Avonian. The results are given of applying the time-scale deduced from the South-Western Province to the Belgian sequence, and shows that the faunal succession is practically the same in both provinces. If the midland and northern developments of England and Wales are compared with that of Belgium, striking identities are observed. The lateral variation of Mid-Avonian lithology is exhibited in a diagram. Correlation of the Belgian sequence with that of the South-Western Province demonstrates that the periods of partial emergence took place consecutively and not simultaneously. The palæontological section contains descriptions of several gentes that are common in Belgium, but rare in Britain. The facts concerning migration and evolution are importants results of extending the area of observation.

Linnean Society, March 5.—Prof. E. B. Poulton, president, in the chair.—Miss K. **Foot** and Miss E. C. **Strobell**: Results of crossing *Euschistus variolarius* and *E. servus*, with reference to the inheritance of an exclusively male character. The specific character is a distinct black spot on the genital segment of *E. variolarius*, which is wanting in the female, and entirely absent from *E. servus*. The authors explained the methods adopted during five consecutive summers, for raising these Hemiptera in captivity. Detailed accounts are given of the history of their specimens, their crossing, and the results in the F_1 and F_2 generations. The exclusively male character, the genital spot, can be inherited without the aid of the Y-chromosome or of the X-chromosome. The genital spot does not behave as a Mendelian unit; neither the spot nor its absence is dominant in the F_1 hybrids; F_2 generation shows even greater variability.—C. F. M. **Swynnerton**: Short cuts by birds to nectaries. Certain birds, and some individuals more than others, apparently disliked being besprinkled with pollen, and tended always to enter flowers by breaches made by themselves or their predecessors. Other birds tried, contrariwise, to enter the flowers by their natural openings and so to be of use to them for cross-fertilisation excepting in the case of individual flowers that happen, through inconvenience in their own or the bird's position, etc., to offer some difficulty. If these were insufficiently protected as well, they were often either pierced or the openings already made in them by the more indiscriminating birds were utilised. Insects also tended to utilise the breaches made by birds, and so probably in large part failed to counteract the latter's discriminative influence. In most cases the eliminative effect, if any, of the damage was not traced. In two instances it was (for individuals) immediate and clear, flowers of a certain type being bodily removed.

Mathematical Society, March 12.—Prof. A. E. H. Love, president, in the chair.—Prof. W. **Burnside**: The rational solutions of the equation $x^3+y^3+z^3=0$ in quadratic fields.—Prof. H. **Hilton** and Miss R. E. **Colomb**: Orthoptic and isoptic loci of plane curves.—G. H. **Hardy**: The roots of the Riemann ζ-function.—Dr. T. J. I'A. **Bromwich**: Normal coordinates in dynamics.

MANCHESTER.

Literary and Philosophical Society, February 10.—Mr. R. L. Taylor in the chair.—R. F. **Gwyther**: The specification of the elements of stress. Part III.—The definition of the dynamical specification and a test of the elastic specification. A chapter on elasticity. The author proposed to simplify the methods current in the treatment of stresses in an elastic body in treatises and papers on elasticity. The chief point of the paper is that full attention should be paid at the outset to the dynamical (or Newtonian) conditions and that the elastic (or Hooke's) conditions should not have the exclusive prominence given to them which has been the established practice.

February 24.—Mr. F. Nicholson, president, in the chair.—M. **Copisarow**: Carbon: its molecular structure and mode of oxidation.—J. B. **Hubrecht**: Studies in solar rotation. An account of a spectrographic determination of the solar rotation, as observed at Cambridge. Photographs were taken showing the displacement of the absorption lines due to the rotation of the sun. The law which has been found by earlier investigators to govern the solar rotation was on the whole confirmed. Two new points, however, appear to be definitely established for the period of observation (fourteen days): (1) that there is a difference in the rotation velocities of the northern and southern hemispheres of the sun amounting to about 54 metres a second; (2) the latitude law expressing the retardation of the rotation away from the equator was found to be more complicated than usual for the period of time in which the observations were made.

BOOKS RECEIVED.

A Junior Trigonometry. By W. G. Borchardt and the Rev. A. D. Perrott. Pp. xv+220+xvii+xx. (London: G. Bell and Sons, Ltd.) 3*s*. 6*d*.

Photo-Electricity. By Prof. A. L. Hughes. Pp. viii+144. (Cambridge University Press.) 6*s*. net.

The Elementary Principles of General Biology. By Prof. J. F. Abbott. Pp. xvi+329. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

A History of Japanese Mathematics. By D. E. Smith and Y. Mikami. Pp. vii+288. (Chicago and London: The Open Court Publishing Company.) 12*s*. net.

The Respiratory Function of the Blood. By J. Barcroft. Pp. x+320. (Cambridge: University Press.) 18*s*. net.

Memoirs of the Geological Survey of England and Wales. Explanation of Sheet 316. The Geology of the Country near Fareham and Havant. By H. J. Osborne White. Pp. iv+96, map (Sheet 316). (London: H.M.S.O.; E. Stanford, Ltd.) 1*s*. 9*d*. and 1*s*. 6*d*. respectively.

Odd Hours with Nature. By A. Urquhart. Pp. 323+plates. (London: T. F. Unwin.) 5*s*. net.

Interpretations and Forecasts. By V. Branford. Pp v+411. (London: Duckworth and Co.) 7*s*. 6*d*. net.

Kapillarchemie und Physiologie. By Prof. H. Freundlich. Zweite Auflage. Pp. 48. (Dresden und Leipzig: T. Steinkopff.) 1.50 marks.

Introduction to Botany. By J. Y. Bergen and Dr. C. W. Caldwell. Pp. vii+368. (Boston and London: Ginn and Co.) 5*s*.

Investigating an Industry. By W. Kent. Pp. xi+126. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Mechanical Refrigeration. By Prof. H. J. Macintire. Pp. ix+346. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Suspension Bridges, Arch Ribs, and Cantilevers. By Prof. W. H. Burr. Pp. xi+417. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 19*s*. net.

The Elements of Electricity. By Prof. W. Robinson. Pp. xv+596. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Die Europaeischen Schlangen. By Dr. F. Steinheil. Heft 5. Plates 21–25. (Jena: G. Fischer.) 3 marks.

The Montessori Method and the American School. By Prof. F. E. Ward. Pp. xvi+243. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Principles of Economics. By Prof. H. R. Seager. Pp. xx+650. (London: G. Bell and Sons, Ltd.; New York: H. Holt and Co.) 10*s*. 6*d*. net.

Knowledge. Vol. xxxvi. Pp. viii+468. (London: 42 Bloomsbury Square.) 15*s*. net.

British Flowering Plants. Illustrated from Drawings by Mrs. H. Perrin, with Detailed Descriptive Notes and an Introduction by Prof. Boulger. Vol. i. Pp. xlv+plates and notes. (London: B. Quaritch.) In 4 vols. 12 guineas net, or on and after March 28 15 guineas net.

South African College. The Annals of the Bolus Herbarium. Edited by Prof. H. H. W. Pearson. Vol. i., part 1. (Cambridge University Press.) 5*s*. net.

Henri Poincaré. L'œuvre Scientifique—L'œuvre Philosophique. By Profs. Volterra, Hadamard, Langevin, and Boutroux. Pp. 264. (Paris: F. Alcan.) 3.50 francs.

A Study of Education in Vermont. Prepared by the Carnegie Foundation for the Advancement of Teaching, at the request of the Vermont Educational Commission. Bulletin No. 7. Parts 1 and 2. Pp 214. (New York City.)

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1912. By Dr. R. Schorr. Pp. 33. (Hamburg.)

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band iii. No. 1. Die Ham burgische Sonnen finsternis expedition nach Souk-Ahras (Algerien) im August, 1905. By Dr. R. Schorr. Zweiter Teil. Pp. 93+17 plates. (Hamburg.)

Die Entstehung der Pflanzengallen verursacht durch Hymenopteren. By Prof. W. Magnus. Pp. 160+iv plates. (Jena: G. Fischer.) 9 marks.

Annual Report of the Board of Scientific Advice for India for the Year 1912–13. Pp. 190. (Calcutta: Superintendent Government Printing, India.) 1s. 6d.

Progress of Education in India, 1907–12. By H. Sharp. Vol. ii. Pp. 292. (Calcutta: Superintendent Government Printing, India.) 3s.

Thirty-Fourth Annual Report of the Director of the U.S. Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1913. Pp. 183. (Washington: Government Printing Office.)

The Diamond Fields of Southern Africa. By Dr. P. A. Wagner. Pp. xxv+347+xxxvi plates. (Johannesburg: The *Transvaal Leader*; London: The Technical Book-Shop.) 1*l*. 7*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 19.

ROYAL SOCIETY at 4.30.—*Discussion:* Constitution of the Atom. Opener: Sir E. Rutherford.
ROYAL INSTITUTION, at 3.—Heat and Cold: Prof. C. F. Jenkin.
CHILD STUDY SOCIETY, at 7.30.—The Dramatic Impulse in Children: Prof. J. J. Findlay.
INSTITUTION OF MINING AND METALLURGY, at 8.—Annual Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Electric Battery Vehicles.
ROYAL SOCIETY OF ARTS, at 4.30.—Indian Water Gardens; Mrs. Patrick Villiers-Stuart.
LINNEAN SOCIETY, at 8.—The Bearing of Chemical Facts on Genetical Constitution: Dr. E. F. Armstrong.
ROYAL GEOGRAPHICAL SOCIETY, at 5.—A Geographical Study of Portuguese East Africa, South of the Zambezi: E. O. Thiele.

FRIDAY, MARCH 20.

ROYAL INSTITUTION, at 9.—Fluid Motions: Lord Rayleigh.
INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Chemical and Mechanical Relations of Iron, Tungsten and Carbon, and of Iron, Nickel, and Carbon: Prof. J. O. Arnold and Prof. A. A. Read.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—Aeroplanes as Engineering Structures: W. H. Sayers.

SATURDAY, MARCH 21.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

MONDAY, MARCH 23.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Lost Explorers of the Pacific: B. Thomson.
ROYAL SOCIETY OF ARTS, at 8.—Surface Combustion: Prof. W. A. Bone.

TUESDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—Landscape and Natural Objects in Classical Art. I. Early Greece and its Precursors: A. H. Smith.
VICTORIA INSTITUTE, at 4.30.—The Number of the Stars: Dr. S. Chapman
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Bellingshausen's Visit to Ono-i-Lau: Sir Everard im Thurn.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Recent Developments in Commercial Motor-vehicles: T. Clarkson.—Comparative Economics of Tramways and Railless Electric Traction: T. G. Gribble.

WEDNESDAY, MARCH 25.

GEOLOGICAL SOCIETY, at 8.—The Geology of Rockall: Prof. J. W. Judd.—The Composition of Rockallite: Dr. H. S. Washington.

THURSDAY, MARCH 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Nature of the Tubes in Marsupial Enamel and its Bearing upon Enamel Development: J. H. Mummery. Oxidation of Thiosulphate by Certain Bacteria in Pure Culture: W. T. Lockett.—The Production of Anthocyanins and Anthocyanidins: A. E. Everest.—Variations in the Growth of Adult Mammalian Tissue in Autogenous and Homogeneous Plasma: A. J. Walton.—(1) The Decomposition of Formates by *B. coli communis*; (2) The Enzymes which are Concerned in the Decomposition of Glucose and Mannitol by *B. coli communis*: E. C. Grey.—Description of a Strain of *Trypanosoma brucei* from Zululand. I: Morphology. II: Susceptibility of Animals: Surg.-General Sir D. Bruce, Major A. E. Hamerton, Captain D. P. Watson, and Lady Bruce.
ROYAL INSTITUTION, at 3.—The Progress of Modern Eugenics. I: The First Decade, 1904–1914: Dr. C. W. Saleeby.
CONCRETE INSTITUTE, at 7.30.—Discussion on Reports of the Science and Reinforced Concrete Practice Standing Committees on: (1) A Standard Specification for Reinforced Work; (2) Advice to Superintendents of Concrete Work; (3) Standard Connections and Joints in Reinforced Concrete.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Current Limiting Reactances on Large Power Systems: K. M. Faye-Hansen and J. S. Peck.
INSTITUTE OF CHEMISTRY, at 8.—Explosives: W. Macnab.

FRIDAY, MARCH 27.

ROYAL INSTITUTION, at 9.—Improvements in Long Distance Telephony: Prof. J. A. Fleming.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—Harmonigraph as Applied to Advertising: A. Forbes.
FARADAY SOCIETY, at 5.—Discussion on Optical Rotatory Power.—Introductory Address: Prof. H. E. Armstrong.—Some Contributions to the Knowledge of the Influence of Certain Groups on Rotatory Power: Prof. H. Rupe.—New Studies in the Rotatory Dispersion of Tartaric Acid and Malic Acid: Prof. H. Grossman.—The Existence of Racemic Tartaric Acid in Solution: Dr. E. Darmois.—Anomalous Rotatory Dispersion: Prof. L. Tschugaeff.—Normal and Anomalous Rotatory Dispersion: Dr. T. M. Lowry and T. W. Dickson. At 8.15.—An Enclosed Cadmium Arc for Use with Polarimeter: Dr. T. M. Lowry and H. H. Abram.—The Relations between the Rotatory Powers of the Members of Homologous Series: Dr. R. H. Pickard and J. Kenyon.—The General Behaviour of Optically Active Compounds as Regards the Dependence of Rotation on Temperature Dilution, Nature of Solvent, and Wave Length of Light: Dr. T. S. Patterson.
PHYSICAL SOCIETY, at 5.—A New Type of Thermogalvanometer: F. W. Jordan.—An Instrument for Recording Pressure Variations due to Explosions in Tubes: J. D. Morgan.—The Direct Measurement of the Naperian Base: R. Appleyard.—An Experiment with an Incandescent Lamp: C. W. S. Crawley.

SATURDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

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THURSDAY, MARCH 26, 1914.

THEODORE ROOSEVELT AS NATURALIST.

Theodore Roosevelt. An Autobiography. Pp. xii+647. (London: Macmillan and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

THE autobiography of Theodore Roosevelt is a very interesting book to the politician or to the political anthropologist; but here I am rightly restricted to reviewing only that part of the book which touches on natural science.

When Mr. Roosevelt entered upon office as President, he found the American Government as represented by Congress and the Senate, comparatively indifferent to the conservation of beauty in the United States—beauty in the form of magnificent trees, magnificent wild beasts, remarkable and beautiful birds, and romantic landscapes. American Senators and Congressmen did not see—any more than British Chambers of Commerce see—that all such things were assets of great national value, of economic importance, indeed. The destruction of bird life throughout the United States was already causing far-reaching plagues of insects, which consumed fruit and vegetables on the extravagant scale in which all natural movements are carried out in North America. American politicians did not appreciate the frightful damage which was being done to the whole North American Continent—Canada as well as the United States—by the unchecked forest fires and the lumberman's lust for destruction amongst the timber of the United States' forests, without any thought of simultaneous measures being taken for reafforestation.

Mr. Roosevelt was not, of course, the first or the greatest pioneer in a movement which has already had most beneficial results in the conservation of beauty and natural resources, and has culminated in the attempt of the United States to set right the bird question throughout the world. Already in the 'eighties and 'nineties of the last century the idea of national parks had come into existence. The Yellowstone region was set apart as a reserve in which natural phenomena, natives trees, and native wild beasts could continue to exist for the wonderment and delight of a new generation. The Yosemite Valley and the big trees of California had been similarly protected from unreasoning destruction. But Theodore Roosevelt, though he had won his spurs as a hunter (and the best book that he wrote about wild life, by-the-by, is not his excellent work on East Africa, but "Outdoor Pastimes of an American Hunter"), had, by the time he became Vice-President, conceived a great love for the natural beauties of a landscape and the presence therein of bird and beast.

During his seven and a half years' tenure of the United States Presidency Mr. Roosevelt established, or caused to be established, fifty-one national bird reservations in seventeen of the United States, as well as in Porto Rico, Hawaii, and Alaska. Amongst these reservations was the celebrated Pelican Island rookery in Indian River, Florida—now world-famous from the beautiful scenes depicted by photography and kinematography; the Mosquito Inlet reservation in Florida (chiefly for the protection of the manati), the reservation of the Klamarth lake and marsh in Oregon (chiefly for the wild ducks, geese, and swans of the western United States); the Tortugas Quay, Florida, for studying the habits of sea-birds and migratory birds; and the great bird colonies (for the protection of albatrosses and petrels) on the Island of Laisan in the Hawaii group, in which direction he intervened after the appalling revelations of bird slaughter by the plumage hunters were made known through the efforts of Dr. Hornaday, Mr. James Buckland, and others. His influence brought about the creation of five national parks—in Oregon, in South Dakota, Oklahoma, North Dakota, and Colorado, and the organisation of four big game reserves in Oklahoma, Dakota, Montana, and Washington, and game laws and game reservations in the vast territory of Alaska.

Mr. Roosevelt also secured the enactment of measures which in the United States not only saved the remains of the bison from extermination, but have led to the gradual increase in numbers and possible future existence of this remarkable bovine. But he has not yet succeeded in making the American Republic call the bison by its right name, instead of the misleading title of buffalo. He is, I fear, rather an advocate for the retention or adoption of a whole series of American misnomers—elk instead of wapiti; bob-cat instead of lynx, mountain-lion instead of puma. In most cases these American terms are the more to be regretted since, with the exception of the puma, nearly all the great mammals of North America had representatives in the fauna of temperate Eurasia, and the English names for these creatures (wapiti, it is true, is Canadian) have a great ancestry going back to the earliest development of Aryan speech in the days of improved stone implements.

What Mr. Roosevelt did for forest preservation is set forth somewhat meagrely in the book under review. Since his quitting the Presidency there has been a set-back under the four years of Mr. Taft, when the recalcitrant party in the Senate got its way, and the lumbermen were once more permitted to destroy unreasoningly. Mr. Roosevelt thoroughly appreciates the fact that the re-afforesting of the United States is a matter of vital importance for climatic reasons, as well as for others, and that the disforesting of these vast territories either by the woodman's axe or by the forest fires, would be a legitimate cause of complaint for the adjoining Dominion of Canada, as the climate of Canada would be affected disadvantageously.

H. H. Johnston.

AMERICAN TEXT-BOOKS OF BIOLOGY.

(1) *A Laboratory Manual of Invertebrate Zoology.* By Dr. G. A. Drew. Second edition, revised. Pp. ix + 213. (London and Philadelphia: W. B. Saunders Company, 1913.) Price 6*s*. net.

(2) *A Text-book of Biology.* For Students in Medical, Technical, and General Courses. By Prof. W. M. Smallwood. Pp. xiv + 285 + xiii plates. (London: Baillière, Tindall and Cox, 1913.) Price 10*s*. 6*d*. net.

(1) DR. DREW'S manual gives directions for the study of ninety-two invertebrates. The accounts of the various types selected for examination are noteworthy for the attention devoted to the reactions of the living creatures, and for the questions designed to test whether the student understands the functions of the several organs and comprehends the adaptations exhibited. In this second edition, the author has cited, at the end of the description of most of the types, a few of the chief memoirs dealing with those types. This is an excellent feature of the book, for the student who follows the lead given will be introduced to the literature of the subject and to the means of becoming acquainted with some of the best methods of modern zoological research. Little consideration is devoted to the larval stages and life-cycles of the types studied, and a detailed account of the internal anatomy of many of the types is not given; the author's intention has evidently been to single out the external features for special study in relation to adaptation. There are descriptions of twelve Polychætes, but of only two insects—a grasshopper and a bee; an account of one of the Diptera, *e.g.*, a mosquito, might have been added with advantage. The descriptions are carefully done, there being very few mistakes. In the section on Gregarina, the organism is said to encyst and form a spore-producing individual—a rather misleading statement. This portion of the life-cycle might have been treated in more detail, and reference made to the formation of gametes and of spores and sporozoites. The poison ducts of Lithobius open on the outer (not on the inner) sides of the second maxillæ.

An appendix contains precise instructions for making permanent preparations of organisms or of parts of them, and there is a useful glossary of terms employed in the book.

The student who works intelligently through the series of types selected for study will acquire a good general knowledge of the structure and chief adaptations exhibited by invertebrates.

(2) Prof. Smallwood has produced an interesting and readable volume, intended chiefly for medical students. Taking the frog as a convenient type, the author describes the physiology of movement, digestion, circulation, and metabolism, and then proceeds to outline the histology of the tissues, the structure of the nervous system, and the development (external features only). A brief account of Hydra and a very short sketch of the Protozoa follow. Succeeding chapters deal with the biology of cells and of yeasts and moulds, parasitism, some biological factors in disease, evolution, variation, heredity, and animal behaviour in its relation to mind. The chapters on variation and animal behaviour are especially interesting, as the illustrative examples are drawn from recent literature. The volume ranges over a wide field, and the accounts of some of the subjects are necessarily brief; in a few cases they are too brief to be of much value to the average student. The account of malaria will not give the student a very clear idea of the life-cycle, for, although the author states that the number of parasites becomes very great, he does not indicate the manner in which this large increase in number is brought about. But the author obviously intends his book to be supplemented by other instruction in the laboratory and lecture-room.

Several mistakes have been allowed to pass, *e.g.*, Bothriocephalus is cited as a type of the Round-worms, sea-anemones are included under Hydrozoa, malaria is stated to occur in frogs, and there are mis-spellings, *e.g.*, Wiederscheim, Unchinaria, etc.

The book contains 243 figures and 13 plates; the illustrations are nearly all well chosen and excellently reproduced, but the figure of Stomoxys represents a fly of entirely different aspect—certainly not a Stomoxys.

SUPERNATURAL RELIGION.

(1) *Modern Substitutes for Traditional Christianity.* By Edmund McClure. Pp. viii+145. (London: S.P.C.K., 1913.) Price 2*s.* net.

(2) *Modern Rationalism as Seen at Work in its Biographies.* By Canon Henry Lewis. Pp. x+418. (London: S.P.C.K., 1913.) Price 4*s.* net.

(3) *All Men are Ghosts.* By L. P. Jacks. Pp. ix+360. (London: Williams and Norgate, 1913.) Price 5*s.* net.

(4) *The Latest Light on Bible Lands.* By P. S. P. Handcock. Pp. xii+371. (London: S.P.C.K., 1913.) Price 6*s.* net.

(5) *The Divine Mystery.* By Allen Upward. Pp. xv+309. (Letchworth: Garden City Press, Ltd., 1913.) Price 10*s.* 6*d.* net.

THE realities of spiritualistic belief are, so far, psychological, subjective. The pathetic paradox about its "apologetics" (science though this styles itself) is that it claims for its realities not only an objective, but a physical, existence. The apologist who condemns "mechanistic" and "materialistic" conceptions of the universe in the same breath introduces a series of super-mechanism and super-matter. Science can do nothing with spiritual entities until they are proved to exist objectively; when this is proved, then they become part of the subject-matter of science, and, therefore, part of the "stuff" of the universe. Matter and mechanism are good terms, but the spiritualist rages at them. The world-substance must be designated by some convenient term; one may serve as well as another; but it is absurd to object to a term because its popular significance suggests solidity and excludes mind.

It is a curious fact that the religion of Western Europe, which from its birth has had an uninterrupted career of success, should have been, from the first, "apologetic." Christianity certainly marked a development of the social consciousness; but it seems as if this apologetic attitude represented a certain mistrust of the spiritualistic material which this last of the old-world religions, and the first and only of the new world, carries with it, apparently as an essential content. The religious impulse is a fact of the emotional life, and with the majority of men requires expression. But Buddhism and Confucianism prove that the religious impulse may be satisfied with a subject-matter that is not supernatural or spiritualistic. If this is so, and if the Christian consciousness is at all mistrustful of traditional supernaturalism, then there is inevitably an air of insincerity about apologetics.

(1) Canon McClure, in an interesting sketch of some modern variations of the supernaturalist point of view, uses the language of science. Miracles, for instance, are "like the mutations or the 'sports' of modern Darwinism." This is good metaphor, but "metaphors are not reasons." He quotes an instance of a frequent temptation to use new scientific discoveries, which have changed our views of matter, as an argument for the objective reality of the supernatural:—

"The very active 'things' which give the atom being are called electrons, and the point of interest to religiously minded people is this, that we have, in these electrons, according to an investigator of world-wide reputation, the nearest analogy to the concept of a disembodied spirit, that is, a charge of electricity pure and simple."

This seems childish; at least, it has no bearing on the argument, and does not help us "to recognise more fully than before that nature and revelation are not in antagonism." The neo-vitalism of Bergson is metaphysical, not scientific. It is regarded by Canon McClure, together with James's similar speculations, as a strong buttress to traditional Christianity. The old religion is better and saner than the modern "substitutes"; why, then, should apologists waste time in trying to prove the material reality of the subject-matter of its creed? The permanence of the religious impulse is not, as this author thinks, a proof of the "validity" (*i.e.* material reality) of supernatural entities; it is a proof of the validity of the religious impulse. This, surely, is enough. The mysticism of Eucken, and the superman of Nietzsche, "theosophy" and "Christian science," "secularism" and "rationalism," are well described and "refuted." It is curious that they should need refutation by a Christian apologist.

(2) Canon Lewis treats of the life and death of famous "rationalists" or "agnostics" by way of showing that the religious temperament produces finer characters than does the agnostic. Voltaire, Paine, J. S. Mill, Renan, Bradlaugh, Spencer, Nietzsche, Goethe, Schopenhauer, George Sand, Shelley, Huxley, George Eliot, Sidgwick, Romanes, and others are described, with emphasis on their moments of dissatisfaction and despair, and with full details of the meannesses of which one or two were guilty. Canon Lewis seems to think that disbelief in the objective reality of certain tenets of Christianity proves a lack of "heart and soul." It proves nothing of the kind; but merely that the person has thought for himself, instead of taking his thinking at second-hand.

(3) "Supernaturalism" has a permanent interest for the imagination. The "ghost story" is as

popular to-day as it was with primitive man. The author of "Mad Shepherds" is an artist. Possibly he is a "believer" (the term always implies materialistic belief) in spirits. His stories of "Panhandle and the Ghosts," "All Men are Ghosts," and "Farmer Jeremy," are fine art, showing an obsession by, and yet a scientific control of, the ghost idea.

"'May it not be that Primitive Religion is the only religion that has ever existed, or will exist, in the world?'

'Panhandle,' I cried, 'you are a ghost!'

'Hush!' he answered, 'we never use that term in addressing one another. . . .'"

"The Magic Formula" is an entirely charming story of child psychology.

(4) Certain exigencies of commission make Mr. Handcock's readable account of archæological discovery in Palestine, Babylonia, Assyria, Egypt, and Syria into a popular illustration of the Hebrew tradition. Thus we find such statements as "the life of Gilgamesh, the hero of Babylonian folklore, whose history presents parallels to many ideas expressed or implied in the Old Testament." "Khammurabi, probably the Amraphel of the Book of Genesis"; "the cause of Israel's migration to Egypt." It has still to be proved that Israel ever was in Egypt; that Khammurabi, and many other historical persons, are really mentioned in the Hebrew books; and that the cosmogony of *Genesis* is anything more than a digest of the Babylonian. The book is an excellent introduction to Mesopotamian and Egyptian archæology, though its particular bias may lead the novice to a wrong perspective. The author is fair enough; the monuments, he admits, "do not do more than mention a few isolated facts out of all that are recorded in the Bible." With the exception of the statement of Menephthah that "Israel is desolated," the first event in the history of Israel or its ancestors certainly attested by the inscriptions is "the invasion of Judah by Shishak under Rehoboam, and the first Israelites whom they mention by name are Omri and Ahab."

(5) Mr. Allen Upward has insight, and has written a suggestive book on the development of religion. The main idea—the Divine Man or Genius—and the stages of his career from medicine man to Messiah, are adaptations from "The Golden Bough"; but the author has had personal experience of savage thought and custom in Nigeria. He has also a sound knowledge of modern thought in general and of the "higher criticism" in particular, and his work, though eccentric in parts (lexicographers will dispute some derivations), has value as an attempt to trace the genesis of Christianity. The central theme, the idealisation of man and the practical work of prophet, priest, and king, is an interesting interpretation of history. But that it has been a predominant factor in the development of culture remains to be proved.

A. E. CRAWLEY.

OUR BOOKSHELF.

A Manual of Petrology. By F. P. Mennell. Pp. iv+256. (London: Chapman and Hall, Ltd., 1913.) Price 7*s*. 6*d*. net.

THE writing of a clear and concise introduction to the study of petrology is fraught with extreme difficulty owing to the fact that the phenomena exhibited by rocks and rock-minerals are seldom capable of simple explanation, and thus the author is often led to assume a wider knowledge of cognate subjects on the part of the elementary student than is likely to be possessed. This book is framed upon a previous work by the same author, entitled, "An Introduction to Petrology"; in fact, a large portion may be regarded as a reprint. The author, however, has rejected much that was in the older publication, and has added new, well-selected matter, but the discussion of the phenomena presented by mineral sections when viewed in polarised light still leaves much to be desired.

Chapters i. to iii. are elementary in character, and deal with the general properties of minerals; the introduction of several tables, such as those dealing with specific gravity, colour, and refractive index, will be helpful to the student.

In chapters iv. to vii. the general characters of the rock-forming minerals are given, and often some simple means of differentiating any one from others which it resembles superficially. The number of species described, however, is slightly larger than is needed in a work of this kind.

The greater portion of the book deals with the classification of igneous rocks and their nomenclature, but mainly with the description of rock-types. The nomenclature has been reduced to its simplest form, and tedious description of unimportant variations have been avoided. The igneous rocks are followed by a brief account of sedimentary and metamorphic rocks.

The book is illustrated with 124 text-figures. Many of the illustrations are excellent, but a few of the figures, such as 66, 77, 86, 119, and 123, might be discarded without prejudice. The book may be described as well planned and methodically carried out; and it gives a good idea of the general nature and scope of the science.

Logging: the Principles and General Methods of Operation in the United States. By Prof. R. C. Bryant. Pp. xviii+590. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 15*s*. net.

THIS text-book on forest utilisation, well printed and fully illustrated, is a very useful addition to the scanty literature on the subject in the English language. The author, who is a professor in the

Yale Forestry School, had formerly practical experience in the lumber camps of the United States and Philippines; and in consequence has been able to give a readable account of the numerous logging methods which are actually in operation. The book should prove suggestive to owners of timber lands in our own Colonies and to Indian foresters.

The first part is general, and comprises chapters on the resources and protection of the forests of the United States. The original woodland area is estimated at 850,000,000 acres, containing about 433,000,000,000 cubic feet of timber. The existing forest has shrunk to 550,000,000 acres, estimated to contain 210,000,000,000 cubic feet, of which the Federal and State Governments control about one-fourth. The second part deals with felling of timber, and contains chapters on labour, tools, organisation of the camp, careful utilisation of the tree, etc. The third part is devoted to transport by land, and is very complete, giving an account of aerial cables, railways, timber slides, and shutes, etc. The rude but efficacious system, by which railroads are often built in the forests of the Far West, is carefully described. The fourth part, transport by water, treats of floating, rafting, flumes, sluices, etc. Another part entitled "Minor Industries," deals with tapping for turpentine, harvesting of tanbarks, etc. A glossary of terms used in logging, tables of wages, timber values, etc., complete this admirable text-book.

Foods and Household Management. A Textbook of the Household Arts. By Prof. Helen Kinne and Anna M. Cooley. Pp. xv+401. (New York: The Macmillan Company, 1914.) Price 5*s*. net.

A FULL treatment is provided in this volume of the production, cost, nutritive value, preparation, and serving of a great variety of foods. The relation of these topics to general household management is made clear, and a careful study of household accounts, methods of buying, and ordinary housewifery is included. Though some parts of the book deal particularly with American conditions, most of the chapters make a direct appeal to teachers of domestic subjects in this country, and the volume deserves their attention.

The Continents and their People. South America. By J. F. Chamberlain and A. H. Chamberlain. Pp. ix+189. (New York: The Macmillan Company, 1913.) Price 3*s*.

THIS beautifully illustrated reading book will serve admirably to supplement the ordinary text-book in use by children studying the geography of South America. The physical and human aspects of geography are presented in such a way as to interest young pupils and to encourage them to trace the connection between the two. There are only three maps in the book; one is an old-fashioned coloured plate, another a photo-relief map of the continent, and the third a sketch map showing rainfall.

LETTERS TO THE EDITOR.

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

The Movements of Floating Particles.

IN reply to Mr. Archdall Reid (March 19, p. 60) I should say that the effects which he describes are the natural behaviour of a contaminated surface. A greasy contamination of the right order of magnitude tends to spread itself uniformly over the surface. If when the liquid in the saucer sways over to one side, the surface layer went with it, the contamination would be concentrated upon that side and diluted upon the other. Such a displacement is resisted. The invisible surface contamination remains nearly equally distributed, and the fact is witnessed by the visible particles floating upon it.

R.

Weather Forecasts.

IN NATURE of February 26 Mr. Mallock verifies the forecasts for London during 1913. He selects four characteristic types accompanying shifts of wind, and finds that the verification did not exceed 58 per cent. The temperature forecasts were even less accurate, being correct only 161 times; and while the given percentage is 52, a truer value, including doubtful and "no" forecasts, would be 44. He then, very properly, raises the question, reduced to its simplest terms, "Is the daily chart with its many entries worth while?" Personally Mr. Mallock thinks it extremely improbable that trustworthy forecasts can be made. Many meteorologists share this opinion. Two deductions can be drawn, either the chart does not contain data suitable for trustworthy forecasting, or the men who forecast are not competent. The latter we can quickly dispose of, for there is no difference of opinion regarding the honesty and professional skill of the staff of the Meteorological Office; and incidentally we may acknowledge the steady rise of the office under Dr. Shaw's progressive leadership to a commanding place among the meteorological services of the world.

Then is the weather chart inadequate? Yes. Moreover, it will be so for years to come. On the other hand, too much may be expected, and a method of verification applied that is entirely too rigorous. Weather is not the only subject on which forecasts are made, and if these were rigorously tested there would be many verifications below 50 per cent. Not long ago, the writer had gently to remind the editor of a metropolitan daily "that the forecaster in his statements concerning things that had not yet happened was more accurate than the Press (in general) in its statements concerning things that had already happened." Errors in law, medicine, and engineering are neither unknown nor infrequent.

To ask for a definite statement of weather conditions twenty-four hours in advance, is asking much in view of the number of indeterminate variables that are operative. Pressure, temperature, air motion, and precipitation are not definite, regular processes, but often erratic and complicated. From our knowledge of the laws of gases we may indeed work out certain functional relationships, but we are still far from determining actual interferences due to circulation, absorption, and radiation.

Shall the chart then be abandoned, and shall we cease troubling ourselves with millions of useless observations to be added to millions already existing? No. It is an honest effort, and granting that there is surplusage of certain data, the chart is still worth while. Besides, there are some by-products of great value. To illustrate, a strict verification of the wind shifts at San Francisco, a city where the lower air circulation is marked, might show a high percentage; but this would not be a fair test of the worth of the weather chart. Rather, some by-product, as that of frost protection. In the first week of January, 1913, the general forecaster warned the orange-growers 480 miles away of impending trouble. Each community was warned not once, but day after day, and night after night. Fruit worth 10,000,000*l*. was in jeopardy. Half was saved because of ample, accurate warnings coupled with improved methods of heating, covering, and protecting. Overtopping the vast saving, was the demonstration that protection was effective. The story of the campaign against frost extending over a period of sixteen years and culminating in the struggle of January, 1913, is one of the most inspiring chapters in the history of horticulture. The forecaster not only gave warning, but developed the principles of protection. At least five basic patents for covering, heating, and mixing the air were obtained and donated to the public.

Again, a certain railroad system of the west coast in competition with all steam railroads of the United States was awarded the Harriman Memorial safety medal. In five years not a single passenger's life has been lost through collision or derailment of trains in a total equivalent movement of 8,000,000,000 passengers one mile. What has this to do with the weather chart? Only this, that during those five years at times of greatest strain, during heavy rains when road-beds wash out, and derailments most easily occur, the actual head of the whole system kept in closest touch with the weather office. Time and time again the patrols on thousands of miles of roads were doubled on the judgment of the forecaster, based on the chart.

Yet, in San Francisco, it has been known to turn out fair when rain was indicated, or some sudden drizzle from the sea mar a forecast of fair weather.

And the conjecture of De Morgan which Mr. Mallock quotes, "that Sir George Airy would not have given $2\frac{1}{2}d$. for the chance of a meteorological theory formed by masses of observations," remains a conjecture.

Alexander McAdie.

Blue Hill Observatory, March 11.

Origin of Structures on the Moon's Surface.

The difficulty raised by the Rev. O. Fisher (Nature, February 26, p. 714) with regard to the origin of the moon by fission from the earth has been answered already in part in Sir George Darwin's own writings. The length of the day when earth and moon revolved once a day was calculated by him at first as about 5 hours, the figure used by Mr. Fisher. Afterwards, Darwin showed that taking solar tidal friction into account, this period should be reduced to something of the order of $2\frac{1}{2}$ hours, when the two bodies would be almost in contact (see Darwin, "Scientific Papers," vol. ii., pp. 323, 364). It may not be amiss to quote here his cautious estimate of this result:—"The whole subject is full of difficulties, and the conclusions must necessarily remain very speculative."

F. J. M. Stratton.

Gonville and Caius College, Cambridge.
March 6, 1914.

The Isothermal Layer of the Atmosphere.

It is a commonplace observation that "truths of science, waiting to be caught," are often simultaneously and independently "caught" by two or more investigators. One of the most remarkable coincidences of this kind appears never to have been definitely pointed out as such. This is the recent Gold-Humphreys (or Humphreys-Gold) explanation as to why the stratosphere is vertically isothermal; viz., because of equality in that region between emitted and absorbed radiation. This discovery is probably destined to remain conspicuous in the annals of meteorology for two reasons; first, because of its intrinsic importance, and, secondly, because of the following remarkable chronological parallelism in its independent development by two investigators:—

Gold.	*Humphreys.*
Preliminary account read at the Dublin meeting of the British Association for the Advancement of Science, September 2–9, 1908.	Preliminary account read at the Hanover meeting of the American Association for the Advancement of Science, June 29–July 3, 1908.
Preliminary account reported in Nature, October 1, 1908.	Preliminary account reported in *Science*, August 21, 1908.
Final paper received by the Royal Society of London, October 5, 1908.	Final paper sent to the *Astrophysical Journal*, October ?, 1908.
Final paper read before the Royal Society of London, December 10, 1908.	Final paper read before the Philosophical Society of Washington, D.C., October 10, 1908.
Final paper published in the Proceedings of the Royal Society of London, A 82, February 16, 1909.	Final paper published in the *Astrophysical Journal*, vol. xxxix., January, 1909.

It would be difficult to find a more interesting chronological parallel. It is particularly pleasant to add that the principals, who up to the time of the publication of their papers were strangers to each other, have since then become well acquainted and the best of personal friends.

C. Fitzhugh Talman.

U.S. Weather Bureau, Washington, March 7.

Unidirectional Currents within a Carbon Filament Lamp.

During the past two months I have shown to some scores of people the effects described by Dr. Eve under the above heading, in Nature of March 12. His explanation of the slow creep of the displaced filaments back to their original positions does not seem to me wholly satisfactory. Other factors governing the phenomenon are the electromagnetic attractions between the current bearing loops and the plastic yielding of the heated filament. It was a search for the latter effect which first directed my attention to the other phenomena.

The negative discharge from a Wimshurst machine also alters the luminosity of the filament, and I have observed in some cases (using a modified Fleming valve), the complete stoppage of the thermionic current. These two latter effects are now being systematically investigated.

F. Lloyd Hopwood.

Physics Department, St. Bartholomew's Hospital Medical College, E.C., March 17.

THE ARCHÆOLOGICAL SURVEY OF NUBIA.[1]

WHEN it was decided to heighten the Aswân Dam, the Egyptian Government also made provision for the thorough examination of the whole tract of country that would be immersed in the enlarged reservoir south of the First Cataract. An account has already been given in NATURE (1911, vol. lxxxvi., p. 283) of the surprising richness of the harvest of historical and archæological results, which Dr. Reisner's precise methods and skill in interpretation were able to rescue from this unpromising and poverty-stricken site during the first six months' work in 1907–1908. For in that short time not only were the main outlines of Nubia's chequered history and strange vicissitudes unveiled, but also, incidentally, considerable light was shed upon many points that hitherto had been obscure in the history of Egypt and the Sudan.

FIG. 1.—Cemetery 87. Groups of C-group superstructures. Grave 24, pottery in position at foot of superstructure. From "The Archæological Survey of Nubia. Report for 1908–9."

So successfully was this work accomplished during the first season's work of the Survey (where, fortunately, the materials brought to light in the neighbourhood of the First Cataract supplied a summary of the whole history of Nubia) that the other three seasons' work could be devoted to filling in the details of the story.

It was very fortunate that it was possible to put together the historical framework at the very commencement of the work, for during the following season Dr. Reisner, who had organised the whole undertaking and set the high standard of scientific accuracy and thoroughness for his successor to live up to, had to relinquish the personal control of the survey in order to resume his work in Syria and at the Giza Pyramids for the Harvard University and the Boston Museum. Happily Mr. Cecil Firth, who had been intimately associated with Dr. Reisner for several years, was available to carry on the work in the spirit and with the thoroughness with which it was begun. In the volumes lately issued the results of the second season's work (mainly Dr. Reisner's) have been fully presented with a conciseness and lucidity distinctive of Mr. Firth's writing.

The district with which the first season's work was concerned chanced to be especially rich in Predynastic and Early Dynastic remains, and thus enabled us at the outset to begin at the beginning and appreciate the condition of Lower Nubia when it was ethnically and archæologically a part of Egypt. The second season equally fortunately yielded most information concerning the succeeding period, when a distinctively Nubian culture was manifesting itself; and these data, which form the outstanding feature of the volumes before us, follow naturally upon the Early Dynastic and Egyptian phase of Nubia's history.

From the time of the Third Dynasty there was a rapid decline of Egyptian influence in Nubia, associated with a degradation of its essentially Proto-Egyptian culture and the infusion of negro blood into its population. "The condition of the country, owing to its isolation from Egypt, had reached a very low ebb, perhaps the lowest in its history, and it is not surprising to find it suddenly displaced by, or incorporated in, a new and vigorous barbaric civilisation which is very obviously southern in its origin, and in no way related to that of contemporary Egypt. It would appear that there was a considerable influx from the south of a slightly negroid population, which brought with it a peculiar culture and art which has very marked affinities with that of Predynastic Egypt in its earliest stage" (pp. 13 and 14). The new and precise information concerning this people which suddenly made its appearance in Lower Nubia "at some time between the Old and the Middle Kingdoms," *i.e.* roughly about 2500 B.C., is the outstanding distinctive feature of this report. Both in the physical characters of the people and the nature of their culture, which is so admirably described in these volumes, this Middle Nubian people is nearly akin to the earliest Predynastic Egyptians; but the two branches of the race became separated the one from the other, and developed independently, one in Egypt, the other further south under the influence of contact with the negro population of Africa. When the latter people, after a separation of perhaps nearly ten centuries, moved north and came into contact

[1] "The Archæological Survey of Nubia. Report for 1908–9. By C. M. Firth. Vol. i., part i., Report on the Work of the Season, 1908–9. Part ii., Catalogue of Graves and their Contents. Pp. vi+209. Vol. ii., Plates and Plans accompanying vol. i. 56 plates+xx plans. Cairo: Government Press, 1912.) Price L.E. 2 (for the two volumes).

with the Egyptians, their culture seems strangely alien, for it retained many features that had been extinct in Egypt for centuries, but now reappear strongly tainted with the effects of negro influence. After reading the masterly interpretation of these data relating to the first appearance of a distinctively Nubian culture in Lower Nubia, it is easy to understand how these puzzling facts have so far misled all other recent writers who have discussed Nubian archæology.

A very interesting feature of this report is the account of the superstructures that are found in association with these Middle Nubian graves, sometimes in the form of "a low dome of stonework (Fig. 94), composed of circular corbelled courses, somewhat analogous to the mud-brick corbel vaults of the Protodynastic period in Egypt" (p. 14), sometimes a simple cairn of stones roughly thrown together or more extensive circular walls of stone surrounding the grave, often with a little 'chapel' for offerings on the east or north-east side. As the derivation of these types

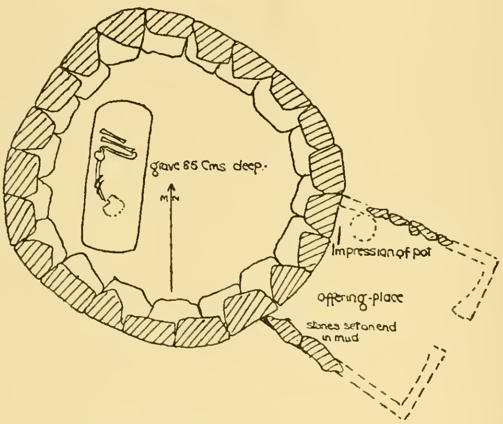

FIG. 2.—Cemetery 87. Grave 61. From "The Archæological Survey of Nubia. Report for 1908–9."

of superstructure from known Protodynastic Egyptian forms is unquestioned, it is very instructive to note that precisely similar circular stone monuments (with offering chapels) have puzzled writers on Algerian archæology (see MacIver and Wilkin's "Libyan Notes," 1901, Chapter xii.), who have not hesitated to class them with the megalithic group of structures in that region.

Limitation of space alone prevents a complete enumeration of all the other important features of these volumes. Further light is thrown upon the destruction of this characteristic Nubian culture, which flourished between the Sixth and Thirteenth Dynasties, by the Egyptian colonisation which followed the military expeditions of Usertesen III. And here, as elsewhere in Mr. Firth's report, it is clearly shown how the facts brought to light in these archæological investigations corroborate and supplement the known historical evidence.

There is now much more precise information concerning an interesting group of negroid people which made its appearance in Nubia between the second and sixth centuries A.D. They appear to be Nubas from Kordofan, perhaps the Nobadae brought into Nubia under Diocletian to check the incursions of the Blemmyes, who in turn were probably the nomadic kindred or descendants of the Middle Nubians who had taken to the Eastern Desert.

The interesting mud-brick forts at Koshtamna, built originally somewhere about the time the famous Giza Pyramids were being erected in Egypt, and frequently repaired and extended in subsequent ages, are fully and lucidly described. So also is the fortified Byzantine town of Sabagura.

There is also much new information concerning the Ptolemaic-Roman and Byzantine periods in Nubia.

The main part of the report consists of the detailed field notes, illustrated by numerous excellent woodcuts and a large volume of photographs and maps. This magnificent record of Prof. Reisner's and Mr. Firth's characteristically thorough survey of an extensive tract of difficult country will be indispensable to everyone who wants to understand the real history of the Nile Valley.

G. ELLIOT SMITH.

THE CRIMINAL AND THE CRIME.[1]

MR. GORING'S Blue Book on the English convict is unquestionably a product of immense patience and industry. In a preface contributed by Sir E. Ruggles-Brise, it is stated that, "In 1901 Dr. Griffiths, Deputy Medical Officer of Parkhurst Prison, formed the idea of subjecting a large number of prisoners convicted of certain similar offences to accurate measurements in order to ascertain whether these showed any deviation from what may be described as the normal, *i.e.* non-criminal persons." Under the encouragement of the Prison Commissioners, especially of Sir Bryan Donkin and Sir H. Smalley, and through the labours of several medical officers, the work grew in scope and magnitude. Ultimately it was placed in the hands of Dr. Goring, who was detached from duty with the view of tabulating the material at University College, with the assistance, and under the direction of Prof. Karl Pearson.

"It soon became apparent that the scope of the work had grown, perhaps inevitably, far beyond its original purpose, viz.: the refutation or confirmation, of the various theories that had been promulgated concerning the existence of the criminal type. It will be seen that the work now embraces a wide range, including not only an analysis of the physical and mental conditions of convicts, but also the data for speculation on very difficult and contentious questions as to the relative influence of heredity, environment, etc. Although the commissioners had not contemplated in the first instance a work of this magnitude, they feel it only fair to Dr. Goring that the work should be published on his own lines, and that

[1] "The English Convict. A Statistical Study." By Dr. C. Goring. Pp. 440. (London: His Majesty's Stationery Office; Wyman and Sons, Ltd., 1913.) Price 9s.

the public should be in possession of the mass of information collated, and statistically tabulated by him, and of the conclusions he draws therefrom. It must also be explicitly understood that the commissioners are not in a position to endorse all the conclusions at which he arrives, or to criticise the method employed in attaining them, as any attempt in this direction would involve an elaborate discussion of matters on which the highest scientific authorities differ."

Part I. of Dr. Goring's work is devoted to an examination of the theories of the late Prof. Cesare Lombroso and his followers. These are shown, we think, quite conclusively to be erroneous. The matter is one eminently suitable for statistical handling. Lombroso stated that criminals are mentally and physically abnormal. A large number of convicts have been examined, and the abnormalities have not been found.

No evidence has emerged confirming the existence of a physical criminal type such as Lombroso and his disciples have described . . . there is no such thing as a physical criminal type (p. 173) . . . there is no such thing as a mental "criminal type" (p. 246).

In chapter i. of part II. we find another statistical summary which must be accepted unless, as is very improbable, it can be shown that the facts are not correctly stated. Convicts as a class are physically and mentally inferior to the general population. They are, on the average, shorter, lighter, and stupider. Thieves, burglars, and incendiaries are especially defective. Criminals convicted of violence or fraud are little, if at all, inferior. A third

indisputable statistical fact has emerged from the investigation. It is that the family incidence of crime is not fortuitously distributed, it is not entirely independent of lineage; that criminals do not occur equally in *all* families of the general community, but tend to be restricted to *particular stocks* or sections of the community: to those stocks tainted with criminal ancestry. And we have found that the intensity of this limitation, the intensity of this parental resemblance in criminal propensity, ranges between 0·45 and 0·6 (p. 364).

But the greater portion of part II. consists of debatable matter. Statistics are not merely summarised, they are interpreted. The inferences are not immediate, but mediate. It is probable that the very facts on which Dr. Goring relies would be used by opponents as foundations for quite contradictory conclusions. Facts very similar actually have been so used times without number. For instance, a generation ago the British Association appointed an anthropometric committee to ascertain the statures and weights of persons engaged in different occupations, in accordance with the principle that—

"The occupation of an individual explains not only the direct effects of physical or mental work on the constitution of the body, but the kind of nurture or sanitary surroundings to which he may have been subjected." The Committee found "the most obvious facts which the figures disclose are the check which growth receives as we descend lower and lower in the social scale."

Dr. Goring's comment is—

"The figures disclose no such check upon growth as an obvious fact. The facts actually revealed are that, as we descend lower and lower in the social scale, the means of stature and weight diminish in value. There is no evidence that the diminution is caused by a check upon growth due to environmental conditions. An inference from these facts of equal validity with the Committee's deduction would be that descent in the social and economic scales of life is associated with a physical inferiority of human stock; in other words, that the professional man, labourer, and artisan, &c., breed their own kind, who in turn pursue the calling of their fathers, *i.e.* the work most suited to their social station, and to their particular type of physique" (p. 193).

Here we have the old dispute as to whether nature or nurture is the stronger. Dr. Goring sets himself the task of "disentangling the influence of *heredity* from a complication of *environmental* influences" (p. 337).

"As seen in the above table, 177, the parental correlation for sexual crimes and crimes of wilful damage to property, is from 0·45 to 0·5; for stealing it is from 0·48 to 0·58. We would assume then from this evidence, that the intensity of the inherited factor in criminality is from 0·45 to 0·5, and the intensity of criminal contagion is anything between 0·05 and 0·1" (p. 367). "Our second conclusion, then, is this: that relatively to its origin in the constitution of the malefactor, and especially in his mentally defective constitution, crime is only a trifling extent (if to any) the product of social inequalities, of adverse environment, or of other manifestations of what may be comprehensively termed the force of circumstances" (p. 371).

In these and many other passages, Dr. Goring appears to maintain strongly that the criminal is born, not made; that parentage counts for much, and training for little; that the child of a criminal has, on the average, the "proclivity" or "diathesis" so strongly developed that he will be a criminal no matter what the circumstances in which he is reared. With some surprise, therefore, we read near the end of the work:—

"But this fact of resemblance does not argue absence of the influence of environment in the development of human beings. It is as absurd to say that, because criminal tendency is heritable, a man's conviction for crime cannot be influenced by education, as it would be to assert that, because mathematical ability is heritable, accomplishment in mathematics is independent of instruction; or that, because stature is heritable, growth is independent of nutriment and exercise. Our correlations tell us that, despite of education, heritable constitutional conditions prevail in the making of criminals; but they contain no pronouncement upon the extent to which the general standard of morality may have been raised by education. We know that to make a law-abiding citizen two things are needed—capacity and training. Within dwells the potentiality for growth; but without stands the natural right of each child born into the world—the right to possess every opportunity of growing to his full height" (p. 373).

This passage is a little vague. Probably instead of "conviction for crime" Dr. Goring means "proclivity for crime," or "chances of conviction for crime." He seems clearly of the opinion that "training" is necessary to make of a normal individual a law-abiding citizen. Presumably such a man may be trained to lawlessness also. He has the capacity for both. In which case the special "proclivity" or "diathesis" of criminals can be nothing more than mere stupidity, mere incapacity to be trained. As expressed by Sir Bryan Donkin:—

"They are, it seems, innately unable to acquire the complex of characters which are essential to the average man, and, according to their surroundings, they follow the path of least resistance. This path is more often than not, but by no means always, the path of unsocial or criminal action" (p. 7).

In conclusion Dr. Goring states:—

"Our tables of figures speak for themselves, we have said; but we do not claim that they utter the last word. . . . A long intimacy with the material discussed in the present Report leads us to believe that better material could, with the experience now attained, be procured; but we are convinced that, at least to a first approximation, our data represent the fundamental interrelationships of criminality" (p. 373). In a note he adds:—"The inquiry, which of all others is most urgently needed, must not be limited to an examination of prisoners and their official records; but must extend beyond the prison walls, and into the homes and haunts of the offenders when at large; and into that wide and most interesting field of research where the experiments of the modern reformatory system are dealing with the child-criminal of the race" (p. 373).

SIR JOHN MURRAY, K.C.B., F.R.S.

THE tragic accident by which Sir John Murray lost his life on March 16 has deprived the world of one of the foremost naturalists of the day, and has sent a thrill of sorrow through the hearts of all who knew him. Though he had passed the allotted span of threescore years and ten, he still so abounded in youthful spirits and enthusiasm, was so active alike in body and mind, so full of work and of plans for further enterprise, that it is hard to believe that a career so distinguished in its past and bearing such continued promise for the future, has been suddenly brought to a close.

Of Scottish parentage, he was born in Canada in 1841, and received there the early part of his education. But in his youth he came to Edinburgh, and at the University there, under J. H. Balfour, P. G. Tait, G. J. Allman, and A. C. Brown, he received the training in physical and natural science that formed the groundwork of his lifelong labours. He soon showed the bent of his disposition towards marine studies, and at the same time his love of personal adventure, by taking, in the year 1868, a voyage in a Peterhead whaler to Spitsbergen and the Arctic seas. In the same year there began that series of pioneering cruises in the *Lightning* and *Porcupine*, by which, during the summers of 1868, 1869, and 1870, Wyville Thomson and W. B. Carpenter obtained so much new information regarding the distribution of life in the ocean. Deep-sea exploration became then a leading preoccupation among the naturalists of this country.

Eventually the general interest in this subject found vent in an application to the Government for a vessel and funds to prosecute the study of the ocean all over the globe. The memorable expedition of the *Challenger* was accordingly organised, which lasted from 1873 to 1876. Wyville Thomson, who had been elected in 1870 to the Chair of Natural History in the University of Edinburgh, was appointed director of the civilian scientific staff of the expedition. Recognising the brilliant promise of John Murray, he chose him to be one of the three naturalists on his staff. To this momentous choice the young aspirant to scientific distinction owed the opening which led to all the varied labours which have made his name so widely known.

When Wyville Thomson died in 1882, Murray, who had proved his remarkable qualities during the course of the expedition, was charged with the editorship of the scientific results of the cruises of the *Challenger*. This was a task the greatness of which is probably not generally appreciated. No ordinary skill, knowledge, tact, and patience were required to allocate the vast pile of collections to the different specialists all over the globe, to keep these writers up to their engagements, and, within reasonable limits of time, to see that the printers and engravers were supplied with material, to supervise the masses of proof-sheets, and, by no means least of all, to battle with an unsympathetic Treasury that grudged the heavy expense necessarily required for the publication of the work of the most completely organised expedition that had ever sailed the seas. Year after year the labours of the editor went on, until some fifty massive quarto volumes were issued. That Murray should have emerged with triumphant success from so prolonged and so trying an ordeal was a striking proof of the strength of his character and the vigour of his scientific enthusiasm.

Besides taking an active part in the dredging and the general biological work of the expedition, Murray specially devoted his attention to the working out of certain parts of the materials obtained. He was more particularly interested in the investigation of the deposits that are accumulating on the floor of the ocean. The ample store of materials which he succeeded in gathering together was subsequently carefully studied by him in concert with the late Prof. Renard, of the University of Ghent, and the conjoint work of the two observers was published as one of the thick quartos of the *Challenger* Reports. This monumental volume possesses a high scientific value, coupled with the historical interest that it gave to the world the first detailed revelation of the nature and distribution of the deposits that are gathering on the floor of the deep sea, and the impressively slow rate at which some of these deposits are being formed.

A further inquiry arising out of the operations of the *Challenger* expedition was the question of the origin of coral islands. The fascinating explanation of these islands proposed by Darwin had been generally accepted by men of science, though some doubts had been thrown upon its universal application. Murray, who was not always disposed to accept the conclusions of his predecessors without subjecting them to rigorous investigation, was led to entertain more than doubts as to the general applicability of Darwin's theory. He ultimately came to the conclusion that the extensive oceanic submergence which the great naturalist's explanation demanded could not be proved from coral reefs. He propounded another view in which he was supported by the late Alexander Agassiz, who undertook many cruises over different oceans, visiting most of the coral regions and obtaining an unrivalled acquaintance with their various features. According to this view, coral reefs have grown up on submarine volcanic peaks, which in many cases have been covered with thick accumulations of calcareous organisms, so as to be brought up within the limits of the growth of reef-building corals. The problem probably cannot be solved by any one universally applicable hypothesis. Whether or not subsidence has played a part in the formation of coral islands there can be no doubt, from the full narratives of Agassiz, that proofs of elevation are conspicuously obvious in many of the groups of these islands.

Sir John Murray's latest expedition took place only four years ago, when at his request the Norwegian Government lent him a surveying vessel, the *Michael Sars*, together with its scientific staff, for a summer cruise of four months in the North Atlantic Ocean, while he himself undertook to defray all the other expenses. The cruise proved highly successful, but perhaps its most important result has been the preparation and publication of a work on the "Depths of the Ocean," the joint production of Sir John himself and Dr. Johan Hjort. This handsome volume is undoubtedly the best and most authoritative treatise on the subject to which it is devoted. It places clearly before the reader the main incidents in the history of the investigation of the deep sea, and it describes the methods of research and the general scientific results obtained, with fresh illustrations from the experience gained in the cruise of the *Michael Sars*. Sir John had already been recognised as one of the chief founders of the modern science of Oceanography, and in this admirable volume he has left what will long be the leading manual on the subject.

It was at his instance that upwards of five-and-twenty years ago the British Government was led to annex Christmas Island, a lonely volcanic peak in the Indian Ocean, which seemed never to have been disturbed by man. He sent out some competent observers to study its geology and natural history, and these visitors found it to be rich in phosphatic deposits. He thereupon formed a company, which obtained a concession to work these accumulations. With the wealth that accrued to him from this source, he has been a generous supporter of scientific investigation in many directions. One of the undertakings which he set on foot and financed was a thorough bathymetrical survey of the freshwater lochs of Scotland by practised observers. The results of this investigation have been published in a series of six volumes. There is probably no other country of which the depths and other features of its lakes have been so fully made known.

Sir John Murray's devotion to science and his sagacity in following out the branches of inquiry which he resolved to pursue were not more conspicuous than his warm sympathy with every line of investigation that seemed to promise further discoveries. He was an eminently broad-minded naturalist to whom the whole wide domain of Nature was of interest. Full of originality and suggestiveness, he not only struck out into new paths for himself, but pointed them out to others, especially to younger men, whom he encouraged and assisted. His genial nature, his sense of humour, his generous helpfulness, and a certain delightful boyishness which he retained to the last endeared him to a wide circle of friends who will long miss his kindly and cheery presence.

ARCH. GEIKIE.

PROF. E. S. HOLDEN.

PROF. HOLDEN, whose death was announced with regret in our last issue, was better known to the astronomers of the last generation than the present. He will be remembered as one who, by his energy and position, encouraged the enterprise and activity that have characterised the development of astronomical research in the United States. It was his fortune, thirty years ago, to be placed at the head of the Lick Observatory, the optical equipment of which was then superior to any that existed. Also the position of the observatory had been selected with care and at considerable expense. He had to construct a programme and to pursue it with such ardour and success that the results should justify the costly erection of the gigantic refractor in a spot remote and difficult of access. In his work as a pioneer he had little to guide him, for though telescopes had gradually increased in power, they had been employed mainly in doing more perfectly what small telescopes had attempted. We may claim that the Lick telescope in his hands was a success. It is, of course, difficult to separate the work of a director from that of the subordinates selected to carry it into effect. The one provides a programme, but the performance must be largely in the hands of the lieutenants.

Prof. Holden was fortunate in the choice of his assistants and in the apportionment of their work. His assistants all increased their reputation under his direction, and demonstrated the capacity of the instrument entrusted to their charge. Barnard added an inner satellite to the Jovian system; Burnham's double-star work remains unsurpassed; Keeler's successful demonstration of the meteoritic constitution of Saturn's rings and his determination of the motion in the line of sight of the planetary nebulæ would have made the reputation of any observatory. Naturally some credit for these successes attaches to Prof. Holden. But his own activities contributed not a little to the high estimation in which the observatory was held. Foremost, perhaps, should be placed his monograph on the nebula of Orion, a useful and painstaking piece of work. Of more originality were his studies of the physical constitution of the sun and its surroundings, the outcome of several eclipse expeditions, some earlier than the appointment to the Lick Observatory. Planetary markings and close examination of the surfaces of such minute discs as those of Jupiter's satellites or the planet Uranus also engaged his attention. The helical forms of nebulæ were the subject of intimate study, and in other directions Prof. Holden displayed equal energy and ability.

Considering the difficulty of getting a new observatory into efficient working order, increased as these difficulties were by the inaccessibility of the situation, it will be admitted that the twelve years' direction from 1885 to 1897 accomplished much useful work. In the latter year Prof. Holden resigned the position of director of the Lick Observatory, and his scientific activities apparently ceased. W. E. P.

NOTES.

The Bakerian Lecture of the Royal Society will be delivered by Prof. A. Fowler on Thursday next, April 2, upon the subject of "Series Lines in Spark Spectra."

We announce with regret the death on March 23, at sixty-eight years of age, of Prof. G. M. Minchin, F.R.S., formerly professor of mathematics, Royal Indian Engineering College, Coopers Hill.

We regret to see the announcement of the death on February 17, at sixty-two years of age, of Dr. G. J. Burch, F.R.S., formerly professor of physics at University College, Reading, and the author of a number of papers upon electrical subjects and physiological optics.

The eighth annual meeting of the British Science Guild will be held at the Mansion House on Friday, May 22, at 4 o'clock p.m., when the Lord Mayor, the Right Hon. Sir T. Vansittart Bowater, Kt., will preside. The annual dinner will be held at the Trocadero Restaurant on the same date, at 7.30 p.m., under the chairmanship of the president of the guild, the Right Hon. Sir William Mather, P.C.

The enormous drain on the mammalian life of the world caused by the fur-trade is strongly emphasised in the following extract from an article in the *Times* of March 19 on the London spring fur-sales:—"Yesterday there were sold in the morning 183,754 skunk skins; in the afternoon 136,623 American opossum and 80,242 raccoons, as well as 3,602 civet cats. To-day will be offered 430,401 skunks, and to-morrow 2,500,000 musquash of various classes. In all there will be sold more than 4½ millions of musquash skins; and it is no wonder that the once familiar musk-rat 'houses,' which used to dot every lake and pond all over the United States, looking like great mole-hills sticking up from among the rushes, are growing scarce." During the three weeks of the sale it is probable that 10 or 12 million skins will have been sold.

The discovery of ancient human remains in German East Africa by Dr. Hans Reck, of the Geological Institute of Berlin University, may prove to be an event of some importance to anthropologists. The report of the discovery, published in the *Times* of March 19, leaves us in some doubt as to the antiquity and racial characters to be assigned to these East African human remains, but apparently they are of mid-Pleistocene date, and show the distinctive features of the negro. If such prove to be the case, we must conclude that the negro race was already evolved in Africa at an earlier date than is now generally supposed. The *Times* report also informs us that the man thus discovered had thirty-six teeth—four more than is given to human and anthropoid races. The teeth are also said to show marks of filing; it would indeed be a remarkable fact if the habit of filing the teeth, so common in modern African races, should have been in use at the early date assigned to these prehistoric remains.

The International Phytopathological Conference summoned by the French Government in conjunction with the Italian Government to meet at the International Institute of Agriculture was inaugurated by his Majesty the King of Italy on February 24, and was brought to a conclusion on March 5, in the presence of all the fifty delegates, who represented the thirty-five States which took part in the conference. By the proposed International Convention adhering States pledge themselves in the first place to take whatever legislative and administrative measures are necessary to prevent the distribution of all diseases of plants in their own countries, but specially to organise an effective service of supervision over nurseries, gardens, glasshouses, and other establishments which carry on a trade in living plants. The measures which adhering States would pledge themselves to take include (*a*) the erection of one or more institutes for scientific studies and research; (*b*) the organisation of an effective service of supervision over nurseries, including the packing and dispatch of plants; (*c*) the issue of phytopathological certificates. They would bind themselves only to admit plants accompanied by phytopathological certificates issued by or from a competent official authority, except in the case of plants which are imported for scientific research at an institute authorised by the Government.

March bids fair this year to establish a record for rainfall, and at Greenwich, where the aggregate rainfall to the morning, March 23, was 3·54 in, the total for the whole month has only been greater in two years during the last century, from 1815. The heaviest record fall is 4·05 in. in 1851, and in 1905 the measurement was 3·57 in.; the latter was exceeded by rain during the day, March 23, and there are nine days which seem likely to be wet, to secure a total of 0·52 in., which will render the present month the wettest March on record for the last one hundred years. At Greenwich there have in all only been eight years with the March rainfall more than 3 in. since 1815. Rain has fallen every day in the month to March 23, with the exception of March 1 and 2, and on March 8 and 9 the aggregate rainfall was 1·43 in., whilst the average for the whole month is 1·46 in. At Camden Square the total rain for the month to March 23 is 4·12 in., which is 0·43 in. more than in any previous March during the last fifty-five years. On March 22 the shade temperature at Greenwich was 29°, which is as cold as any previous reading since January 25, and the terrestrial radiation temperature on March 22 was 18°, which is lower than any grass temperature since January 24. The Greenwich records for the sixty years 1850–1909 show that frost has occurred in thirty-one years on March 22, so that the chances are in favour of frost on that day, whilst on March 20 frost has only occurred in twelve years, which gives the chance of 5 to 1 against frost.

A COMPLIMENTARY banquet was given by members of the medical profession to Surgeon-General Gorgas, sanitary officer of the Panama Canal Commission, on Monday, March 23. Sir Thomas Barlow (president of the Royal College of Physicians) occupied the chair, and the company included many distinguished representatives of medical science. Earlier in the day Surgeon-General Gorgas delivered a lecture before the Royal Society of Medicine on his sanitary work in Panama. In the course of his lecture he said that one-third of the canal zone is low and marshy, and had the reputation for four hundred years of being one of the most unhealthy regions in the world. It is probable that more white men have died there from tropical diseases than at any other place within the tropics. The French began work on the canal in 1880, the Americans in 1904. During the intervening twenty-four years it had been discovered that malaria and yellow fever are transmitted from one human being to another by the mosquito—malaria by the anopheles, and yellow fever by the stegomyia. These discoveries enabled health conditions at Panama to be controlled. Had the Americans known no more about these two diseases in 1904 than did the French in 1880, he did not believe that they could have done any better.—The degree of Doctor of Science, *honoris causâ,* was conferred upon Surgeon-General Gorgas at a special Convocation of the University of Oxford on Tuesday, March 24.

ON Wednesday, March 18, a portrait of Sir William Ramsay, painted by Mr. Mark Milbanke, was presented to the University of London, University College, on behalf of a committee of subscribers, consisting mainly of former colleagues and past students, by Prof. J. Norman Collie. Prof. Collie directed attention to the scientific achievements of Sir William Ramsay. While an assistant in Glasgow, Sir William Ramsay, together with Prof. Dobbie, discovered the fact that a certain number of acids obtained by oxidation of compounds obtained from bone oil and coal tar were identical with the products obtained by oxidation of the alkaloids. After that, when he was professor at University College, Bristol, he brought out a very large amount of extremely interesting work in physical chemistry. On coming to London and University College, his first great discovery, made in conjunction with Lord Rayleigh, was that of argon; and this was followed soon afterwards by the isolation of helium from clevite. Following up these two discoveries, Sir William Ramsay, after five years' hard work with Prof. Travers, succeeded in finally obtaining from the atmosphere three more elements—neon, krypton, and xenon. After this, Sir William Ramsay investigated the emanation that comes off from the element radium. This he obtained in the pure condition above mercury, and noticed that it gradually decomposed and that helium resulted. The portrait was accepted by the Vice-Chancellor of the University (Dr. W. P. Herringham) and by the chairman of the managing subcommittee of University College (Dr. J. Bourne Benson). A replica of the portrait was presented to Lady Ramsay, on behalf of the subscribers, by the Provost of the college in token of the esteem and affection in which Sir William and Lady Ramsay are held at University College. The gift was briefly acknowledged by Lady Ramsay and Sir William Ramsay.

IN the *Times* of March 17 E. Naville gives a further account of his remarkable discoveries at Abydos. He has found a great rectangular reservoir, which is shown to belong to the period of the temple of the Sphinx, when building with enormous stones without ornament came into fashion. This he believes to be the oldest stone monument, in the architectural sense, in Egypt. Some of the pyramids may be older, but, except for the inner chambers, they are without architectural plan. This reservoir was used for the storage of water in high Nile; and it is a remarkable fact that the beginning in architecture is neither a temple nor a tomb, but a gigantic water-work, showing that even in this early period the people had carefully observed the laws of the rise and fall of the Nile, and of the processes of infiltration.

IN the *National Geographic Magazine* for February Mr. W. J. Showalter contributes an interesting article, illustrated by a fine series of photographs, showing how the opening of the Panama Canal has been delayed by the earth slides, particularly in what is known as the Culebra Cut. It was only with the deepening of the canal bed in 1910 that these obstacles became really formidable; in all some thirty million cubic yards of material have been removed. Mr. Showalter describes the geological conditions of the area, with eleven groups of bedded rock and six of igneous formations, the result of volcanic action and uplifting of marine strata. The engineers now intend to check erosion in the Culebra Cut by covering the banks with vegetation, and the ships of the future will pass between banks of tropic green, except at those places where the living rock defies the efforts of the forester.

IN his presidential address to the Society for Psychical Research (published in the current number of the society's Proceedings), Prof. Henri Bergson asked "what would have happened if modern science, instead of setting out from mathematics to turn its attention towards mechanics, physics, and chemistry, instead of bringing all its forces to converge on the study of matter, had begun by the consideration of mind—if Kepler, Galileo, and Newton, for example, had been psychologists." He answered that our psychology would have been almost inconceivably different from what it is. "Foreign to every mechanistic idea, not even conceiving the possibility of such an explanation, science would have inquired into, instead of dismissing *a priori*, facts such as those you study. Vitalism," he continued, "is a sterile doctrine to-day. It will perhaps not be so always, and it probably would not have been so had modern science at its origin taken things at the other end."

THE current number (February, 1914) of the *Journal of Genetics* contains papers dealing with several aspects of the problem of heredity. Mr. R. K. Nabours writes on inheritance in Paratettix, an American genus of locusts. In addition to *P. texanus*, Hanc., he found eight varieties which differ in their colour patterns, and are given new specific names. The inheritance of these colour patterns in crosses is found to be Mendelian in the sense that segregation occurs in the F_2 offspring, the species *P. texanus* being recessive to all the others. In the F_1 the colour patterns of both parents are equally developed, so that there is no phenomenon of dominance. In the experiments, five "unexpected individuals" appeared, which seem to have been due to germinal changes. Long and short wings were found not to be inherited, but to be controlled by environment. Mr. Richardson contributes a note on inheritance in strawberries, and Mr. Salmon describes sterile male dwarfs in the hop. In continuing his studies on the effects of environment on parthenogenetic and sexual reproduction in Cladocera, Mr. Agar concludes that "there is no justification for retaining the hypothesis of an inherent reproductive cycle," the transition from one type of reproduction to the other being entirely under environmental control. Dr. C. J. Bond describes an hermaphrodite Formosan pheasant having the secondary sexual characters of a male on the left side and of a female on the right, and suggests an explanation based on hormones. The utility of the paper on reduplication series, which deals with highly questionable Mendelian hypotheses, is problematical.

THE revived interest in the study of Thysanoptera among English entomologists is shown by the publication of two important papers in a recent number of the *Journal of Economic Biology* (vol. viii., No. 4) on British species of the order, by Mr. C. B. Williams and Mr. R. S. Bagnall respectively. A number of new species are described in each paper. Mr. Williams also describes some new forms from the West Indies.

THE lately issued part of the *Bulletin of Entomological Research* (vol. iv., part 3, 1913) is mostly occupied by two papers combining geographical and economic interest. Dr. J. J. Simpson describes his journeys for entomological research in British West Africa, giving much ecological information and a map to show the ascertained range of five species of Glossina in Sierra Leone. Mr. A. D. Peacock discusses the "Entomological Pests and Problems of Southern Nigeria," describing the principal insects that injure the staple crops of the country—cotton, cocoa, maize, yams, and rubber. The stages of the red "cotton stainer"—a heteropterid bug, *Dysdercus superstitiosus*, are described and illustrated with coloured figures; excellent illustrations of other harmful species are also given.

IN the February number of *Naturen* Dr. A. W. Brøgger discusses certain "kayaks" discovered in Scotland and the isles—two of them so long ago as the seventeenth century—which have been regarded as of a Scandinavian, or rather Finnish, type. Dr. Brøgger states, however, that this is altogether wrong, and that the kayaks, together with the associated paddles and other implements, closely resemble those used at the present day in Greenland. How they reached Scotland and the Orkneys is briefly discussed.

THE greater portion of the third part of vol. iv. of the Annals of the Transvaal Museum is occupied by papers on the results of the zoological section of the Percy Sladen Memorial Expedition to Great Namaqualand in 1912–13, of which section Mr. Paul Methuen was in charge. Mr. Austin Robert supplies the list of mammals collected, while the reptiles and amphibians are discussed by Messrs. Methuen and John Hewitt, and the arachnids by Mr. Hewitt. New species in each of the three last-mentioned groups are described.

As the result of a fifteen weeks' sojourn in South Georgia during the Antarctic summer of 1912–13, Mr. Cushman Murphy (Bull. Amer. Mus. Nat. Hist., vol. xxxiii., p. 63) was led to believe that old males of the sea-elephant had become exceedingly scarce, and that not sufficient were left to impregnate the females. According, however, to the taxidermist who accompanied Major Barrett-Hamilton, this was a temporary deficiency due partly to the visits of a sealing vessel belonging to the Compaña Argentina de Pesca, and partly to an unprecedented slaughter of some 600 males in a single season. During the past season fair-sized and large males are reported to have been relatively numerous.

WE have received from the secretary of the Commission on Zoological Nomenclature, in conformity with the instructions of the congress which require that a year's notice be given before any official exceptions to its rules can be allowed, a memorandum praying for the retention of the old generic names Doliolum, Pyrosoma, Salpa, Cyclosalpa, Appendicularia, and Fritillaria, signed by the following workers on Tunicata:—C. Apstein, A. Borgert, G. P. Farran, G. H. Fowler, R. Hartmeyer, W. A. Herdman, J. E. W. Ihle, H. Lohmann, W. Michaelsen, G. Neumann, C. Ph. Sluiter, F. Todaro. How far the present confusion would be worse confounded by conformity to the new rules may be seen by the fact that what every zoologist knows as Pyrosoma would be called Doliolum, and a new name would have to be coined for the well-known plankton key-form at present termed Doliolum.

IN the *Izvestiya* of the Imperial Academy of Sciences of St. Petersburg (February, 1914) Madame H. I. Poplavska publishes some preliminary results of her botanical researches in the neighbourhood of Lake Baikal. The fauna of the lake exhibits such peculiarities that Prof. Berg has defined it as a subregion of the holarctic region, but the flora has hitherto aroused little interest. The lake affects the distribution of rainfall and the temperature, the summers being much colder in the neighbourhood of the lake than in the surrounding parts of Siberia. Consequently the climate is similar to that of alpine regions and lofty peaks, and the flora is adapted to such conditions. Madame Poplavska mentions several forms peculiar to the Baikal area, some of which differ in so many points from their allied forms in other regions that they may be considered independent species, while others, not having as yet fully adapted themselves to local conditions, show few divergences, and can only be styled varieties. The habitat of these forms and their relation to allied species do not support the view that they are a relict flora.

COUNT DE MONTESSUS DE BALLORE examines the so-called luminous phenomena of earthquakes in a paper published in the latest bulletin of the Seismological Society of America (vol. iii., pp. 187–90). Referring to Galli's catalogue of 148 earthquakes during which luminous phenomena were reported, he shows that the time-intervals between these phenomena and the earthquakes are very variable and sometimes considerable, the accounts come indifferently from the epicentral areas and from distant regions, and the lights appear more frequently from the atmosphere than from the ground. In the great catalogues of Chinese earthquakes, luminous phenomena are never described as attending earthquakes. Two cases are examined in detail. The lights seen during the Valparaiso earthquake of 1906 were probably due to a thunderstorm, and those during the earthquake of November 16–17, 1911, in Germany and Switzerland to meteors. The author concludes that, in the present stage of our knowledge, the existence of luminous earthquake phenomena should be neither affirmed nor denied, but that all the facts at our disposal tend to a negative conclusion.

THE current number of *Symons's Meteorological Magazine* contains an interesting account by Mr. A. H. Hignett of the peculiar behaviour of a cyclonic whirl or tornado which did an immense amount of damage in Cheshire on the evening of October 27 last. It lasted only a few minutes, and its track was about 150 yards wide. It was accompanied by vivid lightning, heavy rain, and a loud noise, said to resemble that of "hundreds of motor-cars crashing through the trees." On entering the county of Cheshire from the north of Shropshire and travelling in a northerly direction, it seems to have risen in the air and passed over about seven miles of country without doing any damage, and then to have descended and struck a tree standing alone in a field smashing it to pieces. It then apparently rose again for about $1\frac{1}{4}$ miles, and afterwards descended and travelled along the foot of the Peckforton Hills (600–700 ft. above sea-level), destroying trees and buildings in its track, and eventually passed into Lancashire near Runcorn. The wind is described as warm, but in South Wales, where the cyclone occurred earlier in the day, it was said to be icy cold. This bounding motion of the whirl is probably by no means an isolated case, and seems to point to another danger to which aviators may be exposed.

DR. P. W. BRIDGMAN, of the Jefferson Physical Laboratory, Harvard University, whose high-pressure research is well known to our readers, has communicated to the American Academy a paper on the technique of high-pressure experimenting which will be of great service to all who wish to follow him in dealing with physical measurement under pressures of ten to thirty thousand kilograms per square centimetre. He gives details of his methods of packing, the construction of his pistons and cylinders, and the connection of his pipes, valves, and pressure gauges. The paper appeared in the February number of the Proceedings of the American Academy.

NO. 209 of the Scientific Papers of the Bureau of Standards deals with the recent determinations of the latent heat of fusion of ice by Messrs. Dickinson, Harper, and Osborne, of the bureau. The natural or artificial ice was cooled in a cryostat to either $-0{\cdot}7°$ C. or $-3{\cdot}78°$ C. before insertion in the calorimeter. Its weight was determined while suspended in the cryostat. Both the electrical method and the method of mixtures were used in measuring the heat of fusion. The former method allows the temperature of the calorimeter to be kept nearly constant during the melting of the ice, and the cooling correction is therefore small. Ninety-two samples of ice were tested, commercial can, plate, and natural ice, and ice made in the laboratory from air-free distilled water were used, and the heat of fusion found to be the same for each to within one part in 1000. The final result is 79·63 calories per gram.

IN the third of his six lectures on new problems of theoretical physics, recently published (in German) by the Ernest Kempton Adams Fund of Columbia University, Prof. W. Wien discusses in an illuminating manner the various electronic theories of the conduction of heat and electricity through metals. The practically infinite conductivity at the absolute zero, rendered probable by the researches of Kamerlingh Onnes, is explained if we assume that the distribution of molecules at the lowest temperatures is perfectly regular, so that the displacement of electrons along certain lines encounters no resistance. The irregularity of distribution induced by rise of temperature and consequent thermal agitation reduces the free path of the electrons, and hence also the conductivity. There is some evidence to show that it is only the mean free path, and not the number of electrons or their mean velocity, which is affected by temperature. Indeed, the lecturer inclined to the belief that even at the absolute zero all electrons have an irreducible kinetic energy, such as is required by the persistence of both diamagnetism and photo-electric effects at the lowest temperatures, not to speak of the expulsion of electrons by radio-active substances in entire independence of the temperature. The question as to whether canal-ray ions emit light in the charged or the uncharged condition is discussed in the sixth lecture. Bärwald showed in 1911 that a magnetic field stops but a small portion of the light emission, whereas most of the positive ions are deflected. This tells in favour of the view that the luminous bodies are uncharged. Even Reichenheim's observation that the whole of the luminous emission from an alkaline-earth anode may be deflected does not invalidate this view, since in this case the mean free path was very small, and every atom was probably charged at least once in the course of its passage.

The increasing adaptation of enzymes to chemical purposes is well illustrated by the utilisation of urease, by Dr. R. H. Aders Plimmer and Miss R. F. Skelton (*Biochemical Journal*, vol. viii., p. 70), in the rapid estimation of urea in urine. The action of the urease of the soy bean has quite recently been shown to be entirely specific; in the communication cited details are given of a process by means of which a rapid and accurate method of estimation is afforded of a substance the analytical determination of which has always presented some difficulty and uncertainty.

During the past few years several active principles have been isolated from ergot which account for most of its peculiar physiological properties; certain other effects have, however, been observed which have not been satisfactorily explained hitherto. In the current number of the *Biochemical Journal* (vol. viii., No. 1) Mr. Arthur J. Ewins describes the isolation from ergot of traces of acetylcholine, a base which produces a peculiar inhibitor effect on the heart, suggesting that caused by muscarine, which had been frequently observed to characterise the use of ergot. That this base is responsible for the effect was shown not merely by its actual isolation from ergot, but by the fact that the synthetic base, prepared from choline, has an identical physiological action.

The following books relating to science are announced by Gebrüder Borntraeger, of Berlin:—"Die wichtigsten Lagerstätten der 'Nicht-Erze,'" Prof. O. Stutzer, Teil. ii., Kohle, Allgemeine Kohlengeologie, illustrated; "Ueber die Bedingungen der Gebirgsbildung," Dr. K. Andrée, illustrated; "Beiträge zur chemischen Petrographie," Prof. A. Osann, Dritter Teil; "Geologischer Führer durch Nordwest-Sachsen," Dr. E. Krenkel, illustrated; "Praktikum der chemischen, biologischen und bakteriologischen Wasseruntersuchung," Prof. O. Emmerling, illustrated; "Geologische Charakterbilder," edited by Prof. H. Stille, illustrated, Heft 18, 19, 20.

The following new books are announced by C. Griffin and Co., Ltd.—In *Biology*.—Practical Field Botany, A R. Horwood, illustrated; in *Chemistry*—A Text-Book of Inorganic Chemistry, edited by Dr. J. Newton Friend, in nine volumes; Elementary Practical Chemistry, for Medical and other Students, J. E. Myers and J. B. Firth; The Storage of Petroleum Spirit, Major A. Cooper-Key; The Petroleum Technologist's Pocket Book, Sir Boverton Redwood and A. Eastlake, illustrated; Oil Chemists' Pocket-Book, Dr. H. Ingle and J. A. Sutcliffe; The Raw Materials of the Enamel Industry and their Chemical Technology, Dr. J. Grünwald, translated by Dr. H. H. Hodgson; in *Engineering*—An Introduction to Town Planning, J. Julian, illustrated; in *Geology*—A Text-Book of Geology, Prof. J. Park; in *Medical Science*—A Practical Handbook of the Tropical Diseases of Asia and Africa, Dr. H. C. Lambart, illustrated; in *Metallurgy*—The Metallurgy of the Non-Ferrous Metals, Prof. W. Gowland, illustrated; Practical Assaying, Prof. J. Park, illustrated; in *Technology*—Clay and Pottery Industries, being vol. i. of the Collected Papers from the County Pottery Laboratory, Staffordshire, by several authors, edited by Dr. J. W. Mellor, illustrated; in *Miscellaneous*—Roberts-Austen: Addresses and Scientific Papers, together with a Record of the Work of Sir William Chandler Roberts-Austen, K.C.B., F.R.S., compiled and edited by S. W. Smith, illustrated; Memorials of Henry Forbes Julian, compiled and edited by his wife, Hester Julian, illustrated.

OUR ASTRONOMICAL COLUMN.

The Forthcoming Total Solar Eclipse.—While the various official and private expeditions are making preparations for observing the total solar eclipse of August 21 next, steamship companies are offering enticing pleasure cruises which include a brief stay on the line of totality on the Norwegian coast. As the last total solar eclipse visible in England took place so far back as the year 1724, and as 1927, the time for the next one, is as yet some time off, the opportunity to view the eclipse of this year should not be lost. The Royal Mail Steam Packet Company's ocean yachting steamer, *Arcadian*, twin screw, and 8939 gross tonnage, is timed to leave Grimsby on August 15 and Leith August 16, and will take up a position near Alsten, north of Torghatten Island, well on the central line. The Norway Travel Bureau of the Great Northern Railway Company has also arranged a special cruise. Passengers leave Newcastle-on-Tyne by the ss. *Venus* on August 15, and join the special steamer *Mira* at Bergen on August 17, a position being taken up at Stokka on eclipse day. It is stated that if a party of seventy-five to eighty members of the Royal Astronomical Society and the British Astronomical Association would avail themselves of this facility no other passengers would be accepted, and the itinerary would be varied to meet the requirements of the party, and the stay at any place in the eclipse zone prolonged.

A Monthly Report on Mars.—Prof. W. H. Pickering has commenced the publication of a series of monthly reports on the appearance of the planet Mars. The first of these was printed in the January number of *Popular Astronomy* (vol. xxii., No. 1, 1914). The observations described are made at the Jamaica Astronomical Station of Harvard College Observatory, situated near Mandeville, at an altitude of 2100 ft., The instrument employed is an 11-in. Clark refractor, and the magnification generally used 660. Prof. Pickering states that the changes on Mars cannot be described as conspicuous except when the planet is viewed under very exceptional conditions, but in their general character they may be detected by careful study, even by those who are not fortunate enough to reside in those portions of the world where the seeing is habitually good. It is in order to emphasise this constant change, unlike changes seen on Jupiter, but resembling more those which occur on our earth, that Prof. Pickering proposed the issue of this monthly bulletin. The present report describes as an introduction the general nature of the nomenclature to be used, and this is generally of a meteorological type, the observations being described under the four headings, snow, clouds, colours and shading, canals and lakes. The observations here dealt with cover the interval from July 27 to October 30, 1913.

A METEORITE FROM ZULULAND.—Prof. G. H. Stanley gives a very interesting description and analysis of a meteorite which fell in the N'Kandhla district of Zululand (*South African Journal of Science*, vol. x., No. 5, January, 1914). The meteorite was observed to fall on August 1, 1912. The first occurrence noted was the usual sound of an explosion, which attracted attention over a considerable area, and a rapidly moving body was seen which left a spiral trail of smoke and at the same time appeared to produce a rumbling or crackling sound. While possibly more than one was found, Prof. Stanley has only been able to locate one definitely, and this forms the subject of his communication. It fell near the junction of the Buffalo and Tugela Rivers, on the Pokinyoni hill in the N'Kandhla district, within a few yards of a native woman. The meteorite weighs nearly 38 lb., and consists almost entirely of nickel-iron alloy, and is therefore classed as a siderite; it is coated with a skin of magnetic oxide exhibiting flow lines, and shows also a profusion of "thumb marks." The communication is accompanied by numerous photographs of the specimen, and also several photographic sections. The complete analytical results are given in percentages as follows: iron, 89·28; nickel, 10·68; silicon, 0·004; sulphur, trace; carbon, 0·030; phosphorus, 0·057; traces of aluminium, magnesium, platinum, and chlorine. The presence of manganese, cobalt, or chromium could not be detected.

A SOLAR OBSERVATORY FOR NEW ZEALAND.—In our issue of July 3, 1913 (p. 460), we announced that Mr. Thomas Cawthron, of Nelson, New Zealand, had offered to build, equip, and endow a solar physics observatory in New Zealand. From a short article in the *Times* of March 23, we learn that Mr. Cawthron is prepared to give 50,000*l*. for this purpose. Mr. J. Evershed, director of the Kodaikanal Solar Observatory in India, who has visited New Zealand to advise as to the erection of the Cawthron Observatory, has spoken highly of the suitability of Nelson, from the geographical and climatological points of view, for the purpose of researches in solar physics.

THE INSTITUTE OF METALS.

THE spring meeting of the Institute of Metals was held in the building of the Institution of Mechanical Engineers on March 17 and 18. The afternoon of the first day was devoted to formal business and to the delivery of the presidential address by the newly elected president, Sir Henry J. Oram, Engineer-in-Chief of the Fleet. The morning and afternoon of the second day were devoted to the reading and discussion of reports and papers. The attendance of members at the meetings was unfortunately rather small, but a large number assembled for the annual dinner, which proved a particularly successful function.

The presidential address was chiefly devoted to the evolution of the Admiralty condenser tube, the various steps being described which have led to the present satisfactory position, in which the number of failures from either corrosion or splitting is as low as one in 60,099 per annum; the steps in question consisted mainly in the imposition of increasingly stringent conditions and tests, and in inducing manufacturers to work to these. Sir Henry Oram also directed attention to the steady decrease in the quantity of non-ferrous metals employed in warship machinery, steel taking the place of brass, bronze, and copper wherever possible. Such a state of affairs points to the need of vigorous progress in non-ferrous metallurgy in order that alloys may be produced which are capable of rendering services to which iron and steel are not applicable.

The nomenclature committee, appointed by the Institute of Metals, but including representatives of the principal technical societies and institutes in this country, presented its first report. The committee was appointed for the purpose of formulating, if possible, a rational system of nomenclature for alloys which should abolish the existing confusion. In its first report the general lines to be followed are laid down; these consist in the construction first of a "systematic nomenclature," in which every alloy is described by the names of its constituent metals, in English, arranged in ascending order of their numerical importance in regard to composition by weight. This logical but cumbersome system is not intended for ordinary daily use, and for this purposes a system of "practical" nomenclature is to be set up, the names comprised in this system being defined as simple verbal abbreviations of the terms of the systematic nomenclature.

The committee has so far presented definitions only of the terms "brass" and "bronze." Brass is defined as an abbreviation for the systematic term "zinc-copper," and therefore when used alone denotes an alloy consisting substantially of zinc and copper only, and containing more copper than zinc. If other metals are present in notable proportions, their names are to be prefixed, so that an alloy containing, say 1 per cent. of tin, would be called "tin-brass." Similarly the term "bronze" is defined as equivalent to "tin-copper." Dr. Rosenhain, as chairman of the committee, in presenting the report, claimed that an important step would be gained if the recommendations in regard to the terms "brass" and "bronze" were widely adopted, because much of the present confusion centred around those very terms; he therefore appealed for the steady support of all concerned on the ground that even if the system put forward by the committee were not the ideally best one, what was really essential was uniformity of nomenclature. In the discussion, Sir H. J. Oram, on behalf of the Admiralty, several important manufacturers and consultants, and some professors and teachers of metallurgy promised their cordial support of the committee's recommendations, so that the committee may approach its further task of defining other alloy names with considerable confidence in the ultimate success of its labours.

Dr. Desch, in his first report to the Beilby Prize Committee, presented a valuable and interesting summary of existing knowledge on the solidification of solids from the liquid state in particular reference to the freezing of metals and Quincke's "foam cell" hypothesis. The report contains a great quantity of information and a useful bibliography; Dr. Beilby commended the impartial and judicial attitude of the reporter, but Dr. Rosenhain likened it to a judge's summing-up, which must, ultimately, be followed by a sentence, and this was unlikely to be in favour of Quincke's hypothesis. Thanks to the further generosity of Dr. Beilby in providing the necessary funds, the committee is in a position to invite a further report on fresh experimental work from Dr. Desch.

A paper by Dr. J. E. Stead and Mr. Steadman, on the "Muntz metal" brasses, dealt with the effects of heat treatment. In this respect the paper was shown —in the discussion—to have been largely anticipated by the much earlier work of Bengough and Hudson, but the paper gave rise to an interesting discussion. This dealt principally with a brass rod which had become disintegrated while in use as a floor-bolt in a high-tension electric power station. The bolt passes through the floor inside a procelain tube, and electrical leakage gives rise to the formation of nitric oxides in the air-space of the insulator tube. In the case described by Dr. Stead, and also in a similar one mentioned by Dr. Rosenhain in the discussion, the brass rod either had some minute cracks, due to slight hollow drawing, when first put in, or these were developed while the rod was in service. The nitric acid gases penetrated into these fissures and produced basic salts of zinc and copper which, by their increased volume, widened the cracks and ultimately led to the complete disruption of the rods. An initially sound, *annealed* brass rod suffers no such damage in the same conditions.

Other interesting papers, by Prof. A. Read and Mr. Greaves, on the influence of nickel on the alloys of aluminium and copper, by Mr. Dewrance on bronze, and by Messrs. Whyte and Desch on the micro-chemistry of corrosion, were read and fully discussed, the eminently successful meeting only terminating late in the afternoon.

AN EELWORM DISEASE OF RICE.

THE appearance of a rice-disease in eastern Bengal so serious that in certain districts the cultivators were in 1911 on the verge of ruin calls for special notice, since rice is, of all important cereals, the one perhaps least subject to serious disease. The matter is dealt with by Dr. E. J. Butler, mycologist to the Agricultural Research Institute at Pusa (Bihar), in a recent pamphlet (Bulletin No. 34, "Diseases of Rice"; Calcutta : Superintendent Government Printing, India, 1913).

The disease in question (called locally "ufra," from a word meaning "above," owing to a belief that atmospheric conditions are responsible for it) has existed long, but has only recently acquired such an intense form as to call for a special inquiry. From Dr. Butler's researches the active cause appears to be an eelworm, *Tylenchus angustus,* closely allied to the nematode which causes tulip-root in oats and other cereals. This Bengal worm, however, differs in its mode of attack from the Tylenchus of wheat and oats. It never enters the tissues of the rice-plant, but confines its ravages to epidemic organs wherever these are sufficiently soft and unsilicified to allow the entrance of the "spear" with which its mouth is armed. The inflorescence, the tissue above the nodes, and the growing point, are such weak places, and here the eelworm, both in mature and in larval stages, was abundantly found in all the plants exhibiting "ufra." The results of the attack of such large numbers of Tylenchus are discoloration of the stem and leaves, arrest of the inflorescence, sterility, and mouldiness. The extent of the damage is not accurately known, but in some districts is estimated to amount to half the normal crop.

This "ufra" disease is of a highly infectious quality. The eelworms swim through the submerged paddy-fields from one rice-plant to another, which they ascend and attack. Like their allies, these nematodes exhibit great powers of resistance to drought, but little to continued submergence; and hence it is somewhat difficult to account for their abundance in such flooded districts as the rice-growing lands in the Noakhali (eastern Bengal) district. Further investigations are needed on the bionomics of these parasites.

With regard to preventive measures, the only hopeful indication at present is the behaviour of transplanted rice in contrast to that of broadcast paddy. Dr. Butler shows that the former, though susceptible of attack by inoculation, is not attacked under ordinary conditions, and advocates an extension of the transplanted crop, the improvement of natural drainage, and the more systematic burning of the stubble. The importance of taking adequate prophylactic measures is seen in the geographical position of the infected area. On one side of it is the enormous paddy area of Bengal, on the other the Irrawaddy Delta, which supplies practically the whole of the export rice of India. "A serious disease of rice," says Dr. Butler, "is one of the greatest calamities that could befall the people" in the infected districts, "(where nearly three-quarters of the cultivated area is under paddy), for no other food crop can replace it."

METEOROLOGY IN NETHERLANDS' EAST INDIA.[1]

THE volume of observations before us contains the hourly readings made at the Batavia Observatory during the year 1910, which is the forty-fifth year of this uninterrupted series of hourly observations. Investigation of the upper air by balloons and kites has been regularly carried on, and important results were obtained. Several of the registering balloons attained heights exceeding 15 km. The number of ascents of pilot balloons amounted to 163; many were followed by means of theodolites to a height exceeding 10 km. The record height reached was 31 km. (on September 12, 1912).

The observations at secondary stations include (*a*) monthly and annual means of air-pressure reduced to the period 1866–1911. The influence of the high mountain range of Sumatra is shown in the deflections of the isobars in the direction parallel to the ridge; in the Indian Ocean, to the south-west of the island, there is a relative air-defect in the west monsoon, and an excess of pressure in the east monsoon. Dr. v. Bemmelen (director) also points out that in the west monsoon the isobars show a remarkable curvative over the sea between Borneo and Sumatra. (*b*) Sunshine observations 1909–11 : the tables give distinct evidence of the way the cloudiness increases with height above sea-level, and that insolation is stronger during the east monsoon in East than in West Java. A further discussion of results is postponed until more data are available. (*c*) Observations of temperature and relative humidity at the agricultural station at Tjipetir, Java, 1906–11. Owing to deficiency of sunshine in the afternoon, the maximum temperature is shifted towards the morning hours.

With respect to the climate generally, Dr. van Bemmelen remarks that rainfall is the ruling factor in the archipelago, as other meteorological elements are almost constant; the average yearly rainfall at Batavia is a little more than 70 in. The study of changes of weather is of little practical importance, as these are trifling, while a storm-warning service is unnecessary, as cyclones do not pass over the area in question. Although it is at present considered unnecessary to construct daily weather charts, the director thinks it would be of great scientific interest if the conditions could be followed by means of synoptical grouping for either weekly or monthly periods. In connection with this view, mercury barometers have been supplied to several places; it is also proposed to establish meteorological stations on a few of the mountains possessing relief of simple form.

[1] (1) Observations made at the Royal Magnetical and Meteorological Observatory, vol. xxxiii. (2) Observations made at Secondary Stations vol. i.

EXPLORATION IN PERU.

THE Yale Peruvian Expedition of 1911 made a number of discoveries which, either for lack of time or means, could not at that time be given the attention they deserved. The most important of these finds were the ruins of Machu Picchu, in the Grand Cañon of the Urubamba, below Ollantaytambo, and a small quantity of human bones apparently interstratified with what seemed to be glacial gravel near the city of Cuzco.

FIG. 1.—Machu Picchu. Sacred Plaza. Chief temple, east side, interior. Copyright by the National Geographic Society.

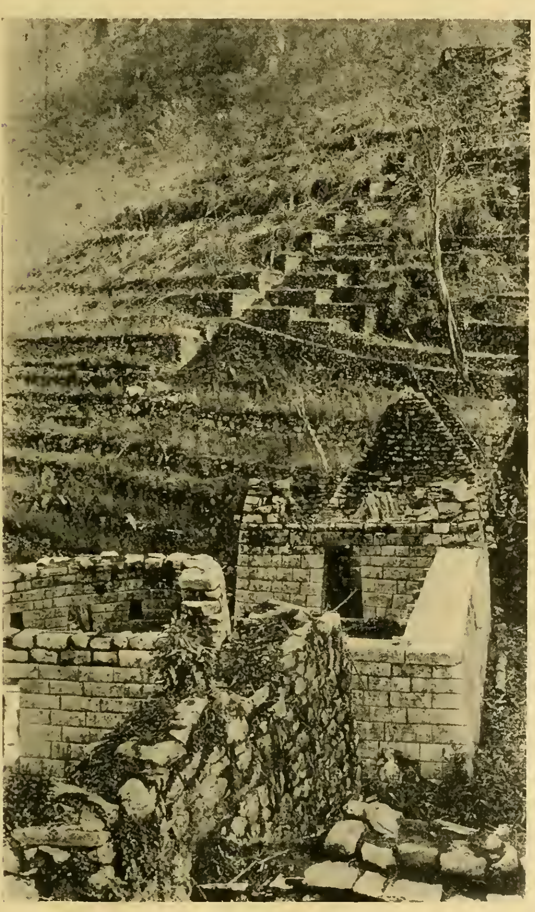

FIG. 2.—Machu Picchu. Princess group. View of round tower and ornamental wall. Shows in distance the agricultural terraces. Copyright by the National Geographic Society.

The Peruvian Expedition of 1912, sent out under the auspices of Yale University and the National Geographic Society, had for its chief objects the further study of these two discoveries and also the completion of certain topographical work planned for 1911, but not finished at that time.

The staff of the second expedition included, besides myself as director, Prof. H. E. Gregory, Silliman professor of geology in Yale University, geologist; Dr. G. F. Eaton, of the Peabody Museum of Yale University, osteologist; Mr. A. H. Bumstead, formerly of the United States Geological Survey, chief topographer; Messrs. K. C. Heald and R. Stephenson, assistant topographers; Mr. E. C. Erdis, archæological engineer; Dr. L. T. Nelson, surgeon; and Messrs. P. Bestor, O. Hardy, and J. P. Little, assistants.

The Cuzco Valley was carefully mapped by Mr. Bumstead and his assistants, and this map will be published in connection with the report on the geology of this valley now being prepared by Prof. Gregory. The geological work undertaken by Prof. Gregory consisted in part of a study ot the gravel deposits near Cuzco, and the relation in age and position of these gravels to the remains discovered in 1911. The result of these researches has not confirmed us in the opinion that the human bones found in 1911 are of very great age. It seems probable, on the other hand, that, owing to recent filling and recutting of the valley, the bones may be of recent origin. Prof. Gregory also carried on a general examination of the structure and stratigraphy of the Cuzco Valley with a view of constructing a geological map of the area tributary to the Huatanay River. The region was found to consist chiefly of sedimentary rock of pre-Tertiary, Tertiary, and Pleistocene age. During glacial times a lake occupied the upper part of the valley.

Not far from Cuzco, in the Apurimac Valley, near Ayusbamba, a small amount of vetebrate fossil material was found and collected by Dr. Eaton. His report on these fossils, which include the remains of both ancient horse and deer, will be published in the *American Journal of Science*.

Anthropometric measurements were made of 145 Indian men in the department of Cuzco, and front and side view photographs were taken of each subject. The Indians represented sixteen provinces and sixty towns. Thirty-eight measurements were taken of each subject. Photographs of many Indian women were also taken in Cuzco and vicinity. The anthropological material collected by Dr. Nelson has been placed in the hands of Prof. H. B. Ferris, Hunt professor of anatomy in Yale University, who is preparing a report which will be published in the near future.

The ruins of Choqquequirau, which had been visited by the present writer in 1909, were reached from the north side by Messrs. Heald, Eaton, and Nelson, of the expedition. A few boxes of bones and potsherds were collected. This party had great difficulty in carrying out its undertaking owing to the fact that no guides could be procured, and the way lay through a very rough country, where scarcity of water and a plague of flies were added to the many other difficulties.

Interesting but not highly important ruins were discovered by the writer near Palcay, in the Aobamba Valley, in the vicinity of an impressive group of glaciers hitherto unmapped and not reported. An interesting feature of one of the groups of ruins in this valley is that it appears to be exactly oriented; its two cross streets seem to run on the true, not on the magnetic, cardinal points.

The topographic cross section of the Andes along the 73rd meridian, begun by Mr. Kai Hendriksen in 1911, was completed in the face of great difficulties by Messrs. Bumstead, Hardy, and Little, and will be published in connection with the report of Prof. Isaiah Bowman, the geographer-geologist of the 1911 expedition.

The most interesting, and in many ways the most satisfactory, results of the 1912 expedition were in connection with the ruins of Machu Picchu. In 1911 the present writer, while engaged in a search for Vitcos, the last Inca capital, discovered a number of hitherto unreported groups of ruins in the valley of the Urubamba and its tributaries. The group known as Rosaspata, near Puquiura, in Vilcabamba, is believed to be that which the chroniclers called Vitcos, the capital where the young Inca Manco, set up by Pizarro, fortified himself after his revolt against the Spanish conquerors. But the ruins of Machu Picchu do not appear to have been connected with the later history of the Incas. These ruins are located on top of a ridge in the most inaccessible part of the Urubamba Cañon some 2000 ft. above the rapids, and some 8000 or 9000 ft. above sea-level.

FIG. 3.—Machu Picchu. Sacred plaza and Intihuatana Hill from boulder caves. Copyright by the National Geographic Society.

The presence here, in a wonderfully picturesque position, of a remarkably large and well-preserved abandoned city practically untouched by the hands of the spoiler, and apparently unknown to the Spanish chroniclers, led us to undertake to clear the city of its extensive jungles and to excavate the ruins. Many difficulties had to be overcome, but we were eventually successful in locating more than one hundred burial caves. The excavation yielded a considerable amount of anthropological material, including human and

FIG. 4.—Machu Picchu Sacred plaza. Chief temple, north wall, interior, showing the cracking caused by the settling of the east wall. Notice the care with which the size of the stones is made to decrease gradually in each ascending tier. The main altar stone is 14 ft. in length. Copyright by the National Geographic Society.

animal bones, a large number of potsherds and a few stone, silver, and bronze implements. Nothing of gold was found, and only half a dozen small silver pins and pendant discs.

The city itself contains about two hundred edifices. Most of the walls are standing and many of the terraces are in good repair. The roofs of the houses disappeared long since, and a large part of the city was completely overgrown with a tropical forest. Trees 2 ft. in diameter were found growing on top of the walls of the houses, and in some cases on the very peaks of the gables. A majority of the houses are of a storey and a half in height with gable ends.

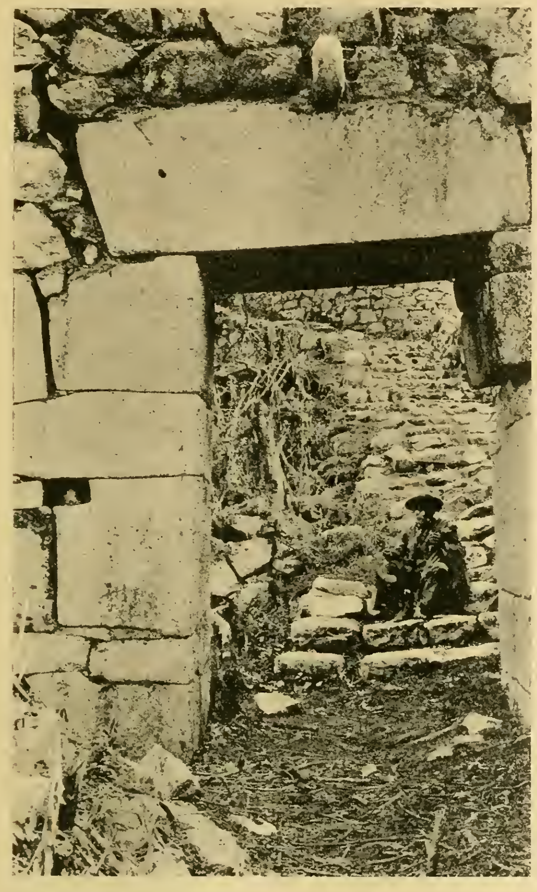

FIG. 5.—Machu Picchu. City gate, interior. Notice the lock hole containing granite cylinder on left and projecting ring stone over the lintel of the doorway. The gate, probably of wood, was either swung from the ring stone or fastened to it and balanced by a log fastened to the stone cylinders in the lock hole on either side of the gateway. A similar device was used also in the entrance doors to each isolated group of houses. Copyright by the National Geographic Society.

Perhaps the most conspicuous features of Machu Picchu are the number of stairways and the large number of windows in the houses. There are more than a hundred stairways, large and small, within the city. Some of them have more than 150 steps. In some cases the entire stairway of from six to ten steps was cut out of a single granite boulder. The water supply must always have been very scarce. We were there during the dry season, and with forty workmen found the available springs only barely sufficient for cooking and drinking purposes. The town may have had a population of two thousand people on occasion.

In the four months of field season, the ruins were practically cleared of all forest growth, and a large part of the débris was burned and removed. From twenty to forty workmen were kept continuously at work under the direction of Mr. Erdis.

One of the most interesting facts brought out as a result of the clearing was that the city was at one time divided into wards, or clan groups, each of which had but one entrance, a gateway furnished with the means of being solidly fastened on the inside. Each one of the clan groups has certain distinctive features, one having its own private gardens, another being distinguished by the ingenuity of the stone work, while still another is marked by having monolithic lintels over the doorways, and unusually steep gables. Machu Picchu contains examples of nearly every variety of architecture known to the Incas and their predecessors on the Peruvian highlands, including fine specimens of the most exquisite stone cutting that can be found anywhere in the New World. One of the most interesting structures is a temple containing three conspicuously large windows. Another is composed of several large blocks of granite, three of them being more than 12 ft. in length. These are shown in the accompanying photographs.

Machu Picchu is in a remarkably good state of preservation, and its architecture has not become confused by Spanish efforts to build churches and villas. The people who lived here were masters of the art of stone cutting. They know how to make bronzes, and they had considerable artistic sense. Their pottery is characteristically Inca in form and ornamentation, but some of the patterns and shapes are practically unknown in European museums.

Just where Machu Picchu comes in the history of the Incas is still a puzzle. It is too early to speak definitely. In many ways it appears to be closely related to Cuzco. One of the buildings bears a strong resemblance to the famous Temple of the Sun, now the Dominican Monastery. It is safe to say that Machu Picchu was essentially a city of refuge. There is no part of the Andes better defended by nature than this Grand Cañon of the Urubamba. Granite precipices, frequently more than 1000 ft. sheer, present difficulties of attack and facilities for defence which cannot be excelled. Furthermore, the natural defences were strengthened by the construction of high walls and a dry moat.

A careful survey of the ruins and the neighbouring cañon was made by Mr. Stephenson. More than seven hundred photographs of the ruins were taken by the writer, who has in hand the preparation of a complete report on the ruins and the material collected at Machu Picchu.

HIRAM BINGHAM.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Estimates for Civil Services for the year ending March 31, 1915, are being issued as a series of Parliamentary Papers. The following particulars referring to the money under this heading to be devoted to scientific work and to higher education are taken from the paper entitled, "Class IV.—Education, Science, and Art."

Under the heading, "Scientific Investigation, etc.," we find that the grants in aid for 1914–15 amount to 100,697*l*., which represents a net decrease of 11*l*. on the amount voted in 1913–14.

The grants enumerated under the heading of the Royal Society amount for 1914–15 to 25,550*l*., as compared with 27,150*l*. in 1913–14. This grant includes the usual 4000*l*. in aid of scientific investigation and 1000*l*. for scientific publications; the remainder of the amount is for the expenses of the Magnetic Observatory at Eskdalemuir, and for the National Physical Laboratory. For salaries and other expenses of the National Physical Laboratory the grant for 1914–15 is 7000*l.*, as compared with 12,000*l.* in 1913–14; but the grant for the Aeronautical Section of the National Physical Laboratory, which is given separate mention, is for 1914–15 12,550*l.*, as compared with 9150*l.* in 1913–14.

The following grants remain as they were in 1913–14:—Meteorological Office, 20,000*l.*; Royal Geographical Society, 1,250*l.*: Marine Biological Association of the United Kingdom, 1000*l.*; Royal Society of Edinburgh, 600*l.*; Scottish Meteorological Society, 100*l.*; Royal Zoological Society of Ireland, 500*l.*; Royal Scottish Geographical Society, 200*l.*; International Geodetic Association, 300*l.*; Solar Physics Observatory, 3000*l.*; North Sea Fisheries Investigation, 1250*l.*; International Seismic Association, 210*l.*

The grant to the Edinburgh Observatory is 1637*l.*, an increase of 89*l.* on 1913–14; and the British Antarctic Expedition receives 5000*l.* for the year 1914–15.

The grants in aid of the expenses of universities and university colleges amount for the year under consideration to 287,000*l.*, precisely the same sum as in the previous year.

The vote for science and art in Ireland reaches 145,164*l.*, as compared with 140,450*l.* in the previous year, a net increase of 4,714*l.* The estimate of the amount required for grants under the Irish University Act, 1908, is 124,000*l.*, a decrease of 1800*l.*

The estimate of the amount required to pay the salaries and expenses of the Board of Education and of the various establishments connected therewith is 14,730,621*l.*, a net increase of 70,552*l.* Among the items included in this large sum the following are of interest in this connection:—Technical institutions and evening schools, 638,000*l.*, an increase of 23,200*l.*; university institutions in respect of technological work, 48,000*l.*, an increase of 2000*l.*; Imperial College of Science and Technology, 30,000*l.*; Science Museum, 21,322*l.*, an increase of 2895*l.*; Geological Museum, 3925*l.*, an increase of 176*l.*; and the Geological Survey, 16,828*l.*, a decrease of 1047*l.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The first award of the Kelvin gold medal and prize (founded by Lady Kelvin), for the best dissertation in natural philosophy presented for the degree of D.Sc. during the three years 1911–13, has been made to Dr. A. D. Ross, now professor in the University of Western Australia.

The first award of the William Jack prize (founded in honour of Emeritus Professor Jack), for the best dissertation in mathematics presented for the degree of D.Sc. during the four years 1910–13, has been made to Dr. R. J. T. Bell, senior University lecturer in mathematics.

LEEDS.—Mr. Aldred F. Barker, who has been head of the textile department of the Bradford Municipal Technical College for twenty years, has been appointed to succeed Mr. Roberts Beaumont as professor of textile industries. Mr. Barker is an old student of the University, having worked under Prof. J. Beaumont, the first occupant of the chair to which he now succeeds. He has had a considerable experience of actual mill work, and his publications are recognised as standard works on textiles.

Mr. Robert Cattley has been appointed honorary fellow in pathology, and Mr. Lionel Walmsley as honorary curator of the Marine Laboratory, Robin Hood's Bay.

MR. F. J. NORTH, assistant in the geological laboratory, King's College, London, has been appointed assistant keeper in the department of geology in the National Museum of Wales.

A COURSE of lectures on arts of East and West, by Laurence Binyon, will be given at the Battersea Polytechnic, London, S.W., on Wednesdays at 6 p.m., beginning May 6. The lectures are intended for advanced students; admission is free, and no ticket is required.

MR. PERCY COLEMAN, of the Northern Polytechnic Institute, Holloway, who has been appointed adviser in technical education and secretary to the National Board for Technical Education in the Union of South Africa, leaves for South Africa in the R.M.S. *Kinfauns Castle* on April 11.

A SUMMER School in Geography will be held on August 2–22 next at the University College of Wales, Aberystwyth. Prof. H. J. Fleure, lecturer in geography at the college, will give ten lectures on a regional survey of Europe, and eight on England and Wales. Mr. W. E. Whitehouse will give eight lectures on the teaching of geography by modern methods, five on the climate of the British Isles, and five on mathematical geography. In addition to the courses of lectures, practical work will be taken daily. Field classes will be held for practice in the use of simple survey instruments, while excursions will be made to places of interest, which afford material for the study of land sculpture, vegetation, and human facts.

WE learn from the *Times* that in accordance with a resolution passed at the joint meeting of the German and English sections of the King Edward VII. British-German Foundation, instituted by Sir Ernest Cassel, the German Foundation will again, in the year 1914–15, use part of its income in providing studentships to enable university graduates of British nationality to reside in Germany with the object of studying some branch of science or literature, or becoming acquainted with the commercial or industrial life of the country. The work of selection was even more difficult than last year, as the number of candidates was far larger, and most of them had obtained first-class honours in their universities. Studentships of the value of about 175*l.* were on March 21 awarded to Mr. B. Dickins, Magdalene College, Cambridge; Mr. R. A. Frazer, Pembroke College, Cambridge; Mr. S. W. Rawson, Queen's College, Oxford; Mr. G. G. Williams, Christ Church, Oxford; Mr. F. P. Wilson, Birmingham University and Oxford University; Mr. T. Wright, King's College, London University. Studentships of the value of about 100*l.* were awarded to Mr. A. B. Mayne, Balliol College, Oxford; Mr. J. S. Stephens, St. John's College, Cambridge.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 11.—Dr. A. Smith Woodward, president, and afterwards Dr. H. H. Bemrose, vice-president, in the chair.—E. T. **Newton**: A series of small mammalian and other remains from the rock-shelter of La Colombière, near Poncin (Ain). During the year 1913, Dr. Lucien Mayet and M. Jean Pissot were working systematically at the prolific deposits of this locality, and towards the end of the year made known the discovery of a number of incised bones and stones, representing the human form as well as several animals. The upper part of the deposit is referred to the Neolithic and Magdalenian ages; but below this, at a depth of $6\frac{1}{2}$ ft., a bed (10 in. thick) was found, which yielded the incised drawings above-mentioned, as well as numerous mammalian remains and flint-implements; and this is regarded as of Aurignacian age. Immediately below the last-mentioned bed a deposit of sand and small rock-fragments was penetrated to a depth of 10 ft., and this deposit, also referred to the Aurignacian, was found to contain an enormous number of bones of small mammals and other animals. Some twenty species have already been recognised by the discoverers.—Dr. A. Smith **Woodward**: An apparently Palæolithic engraving on a bone from Sherborne (Dorset). The author is indebted to Mr. R. Elliot Steel, of Sherborne School, for the opportunity of studying a fragment of bone bearing an incised drawing of the fore-part of a horse in the style of drawings already well known from several habitations of Palæolithic man. The specimen was found in an old mound of débris from a quarry in the Inferior Oolite near Sherborne. No associated specimens of any interest were recovered; but at the lower end of the same valley, about a quarter of a mile distant, teeth of mammoth and woolly rhinoceros have been found. Like the only other British specimen hitherto discovered—that described by Prof. Boyd Dawkins from the Creswell caves—the drawing is made on a fragment of rib; and the neck of the horse is fringed by fine lines, which indicate the short hog-mane usual in sketches made by the Palæolithic race.

Royal Astronomical Society, March 13.—Major E. H. Hills, president, in the chair.—Dr. F. W. **Dyson**: Greenwich determinations of the photographic magnitudes of stars brighter than 9·0 m. between declination $+75°$ and the pole. The methods employed and the results obtained were described.—Dr. S. **Chapman**: The total light of the stars. His results showed that the total light of the stars was about equal to that which would be given by 630 stars of the first magnitude. The light given by stars of each magnitude somewhat increased down to the tenth magnitude, the greater number of stars compensating for the decrease of brightness of the individual stars. But below the tenth magnitude this was no longer the case, the light falling off more and more as we descend the scale.—Prof. J. W. **Nicholson**: The spectrum of hydrogen and helium.—H. H. **Turner**: Baxendell's observations of variable stars, edited by H. H. Turner and Miss Blagg. Difficulties had arisen through Baxendell's various ways of naming the stars, but a more serious matter was that there were so many unfortunate gaps in the series of observations. Comparison with the Rousdon observations showed discrepancies, which might be attributed to the attempt to estimate the maximum—always an extremely difficult matter.

Physical Society, March 13.—Dr. A. Russell, vice-president, in the chair.—Dr. C. **Chree**: Time measurements of magnetic disturbances and their interpretation. The paper is a sequel to one read in November, 1910, dealing with the times of commencement of fifteen magnetic disturbances discussed by Mr. R. L. Faris, and supposed by him to support Dr. L. A. Bauer's theory that the commencing movements of magnetic storms travel round the globe at rates of the order of 100 km. a second. The author suggested then that, for an adequate test of Dr. Bauer's theory, data could only be obtained from a number of stations encircling the earth. Shortly afterwards Dr. Bauer issued a circular requesting magnetic observatories to send him their measurements of the times of commencement of the fifteen magnetic storms. Upwards of thirty stations sent in data. A discussion of the data derived from the horizontal force curves has been published by Dr. Angenheister, whose conclusions are unfavourable to Dr. Bauer's theory. The present paper deals with the data from the declination and vertical force curves as well as those from the horizontal force curves. The bearing of the data on Dr. Bauer's theory is discussed.—H. N. **Mercer**: The ratio of the specific heats of air, hydrogen, carbon dioxide, and nitrous oxide. The object of the experiments was to test the accuracy with which γ could be measured, employing small quantities of the gas, with the view of experiments on the variation of γ with temperature. The method employed was to observe with a platinum thermometer of very fine wire the instantaneous fall of temperature corresponding to a given rapid fall of pressure. The apparatus employed was similar to that used by Makower, but it was found that with due precautions an equal degree of accuracy was obtainable with a vessel of only 300 c.c. capacity. A table is given showing the values of the specific heat at constant pressure for the various gases as calculated from the present experiments. The values show good agreement with direct calorimetric determinations.—A. J. **Philpot**: The asymmetric distribution of the secondary electronic radiation produced by X-radiation. Prof. S. P. **Thompson**: A lecture experiment on the irrationality of dispersion. Newton's method of crossed prisms throws an oblique spectrum on the wall. If the prisms used are of identical kinds of glass the oblique spectrum is straight from red to violet; but if different kinds of glass are used, the spectrum is curved by reason of irrationality of dispersion. If a diffraction grating is used instead of one of the prisms, then the curvature observed is that resulting from the irrationality of dispersion of the particular prism employed. To exhibit these effects in the lecture theatre a diffraction grating of 12,000 lines to the inch is employed to cast a horizontal spectrum of the first order, the light from an arc lamp being sent through a small hole. On interposing a prism to disperse the light vertically upwards, the resultant oblique spectrum is finely curved, being concave upwards.

Zoological Society, March 17.—Prof. E. A. Minchin, vice-president, in the chair.—L. N. G. **Ramsay**: (1) The annelids of the family Nereidæ, collected by Mr. F. A. Potts in the N.E. Pacific in 1911, with a note on Micronereis as a representative of the ancestral type of the Nereidæ. (2) The genera Ceratocephale, Malmgren, and Tylorrhynchus, Grube.—A. Kynvett **Totton**: The structure and development of the caudal skeleton of the Teleostean fish, *Pleuragramma antarcticum*.—G. C. **Robson**: Report on Mollusca from Dutch New Guinea collected by the British Ornithologists' Union and Wollaston Expeditions. In general, the collection appears to endorse Hedley's views as to the Oriental affinities of the Papuan molluscan fauna. Though numerically small in species and individuals, the collection has yielded two genera and three new species, the anatomy of all of which is described.—P. R. **Awati**: The mechanism of suction in *Lygus pabulinus*, Linn. This is a Capsid bug injurious to the foliage of the potato, on which it feeds. A detailed description of the morphology and anatomy of those organs of the head concerned in sucking the plant-juices is followed by an account of their mode of action, in part deduced from their structure and arrangement, in part derived from observation of the living insect.—K. G. **Blair**: Report on the Heteromerous Coleoptera collected by the British Ornithologists' Union and the Wollaston Expeditions in Dutch New Guinea. The most interesting feature of the collection, from the point of view of distribution, is the occurrence of *Cissites maxillosa*, Fab., in this region. This beetle has been hitherto regarded as peculiar to the Oriental region, its range extending from Assam to Java, Borneo, and the Philippine

Islands; it has also been found in Ceylon.—R. **Lydekker**: The Malay race of the Indian elephant. The author made the young Negri Sembilan elephant, formerly living in the society's gardens, the type of a new race, *Elephas maximus hirsutus*, subsp. n., characterised by the square, instead of triangular, form of the ear, the early date at which its upper margin is bent over, and the presence in the young condition—at least, in some cases—of a thick coat of black and in part bristly hair.—Prof. W. J. **Dakin**: The fauna of Western Australia: (1) the Onychophora, (2) the Phyllopoda.

Mineralogical Society, March 17.—Dr. A. E. H. Tutton, president, in the chair.—F. P. **Mennell**: An occurrence of bornite nodules in shale from Mashonaland. The ore-body of the Umkondo mine in south-east Mashonaland consists of a bed of shale through which are scattered nodules of bornite, most probably pseudomorphous after concretionary pyrites. The enclosing rocks are of the same age as the Waterberg series of the Transvaal, and contain pseudomorphs after salt in some of the shale bands. The occurrence of copper and salt at nearly the same horizon is paralleled in the Lower Keuper beds of Europe.—A. **Scott**: Augite from Bail Hill, Dumfriesshire. It occurs in crystals, which are black in colour, but yellowish-green in thin sections, and of two types, simple and twinned, and have the axial constants $a:b:c = 0{\cdot}5844:1:1{\cdot}0932$, $\beta = 105^\circ\ 48'$, and refractive indices 1·708, 1·713, 1·728. Sections parallel to the plane of symmetry show the hour-glass structure characteristic of titaniferous augite.—Dr. G. T. **Prior**: A sulpharsenite of lead from the Binnenthal. Analysis of the crystals, on which the prism zone alone was developed, showed that the composition corresponded to the formula, $3PbS.2As_2S_3$, which is that attributed to rathite; crystallographically, however, the crystals seem nearer to dufrenoysite.—Dr. G. T. **Prior**: Phacolite and gmelinite from co. Antrim. In both instances analyses of these minerals, which are varieties of the same species, differing in habit of crystal, showed an excess of hydrated silica over the composition represented by the formula, $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.

Royal Meteorological Society, March 18.—Mr. C. J. P. Cave, president, in the chair.—Prof. A. C. **Seward**: Climate as tested by fossil plants. The difficulty of using fossil plants as tests of climate becomes increasingly great in proportion to the degree of difference between the extinct types and their nearest living relations. It is from the examination of petrified plants, the delicate tissues of which are almost perfectly preserved, that data may be obtained throwing light on climatic conditions. This method of inquiry is best illustrated by a consideration of some of the anatomical features of the leaves, stems, and roots of trees which grew in the forests of the Coal period; the form and arrangement of cells in the leaves indicate fairly bright sunlight; large spaces in the cortex of roots point to growth in swamps. The geographical distribution of plants during the latter part of the Palæozoic era affords evidence of the existence of two botanical provinces, a northern province characterised by a luxuriant flora living under conditions more genial than those to which the poorer flora of the southern hemisphere was exposed. The presence or absence of rings of growth in the petrified stems of plants may afford evidence of the occurrence or absence of seasonal changes. A general survey of the Jurassic flora of the world leads to the conclusion that the climate was comparatively uniform, and in Arctic and Antarctic regions much more genial than at the present day. The fossil floras of more recent geological periods furnish clear evidence of subtropical conditions in Europe; in later times the occurrence of northern types in Britain heralds the approach of the Glacial period, and in post-Glacial beds are found fragmentary remains of immigrants from neighbouring floras which have largely contributed to our present flora.

Paris.

Academy of Sciences, March 9.—M. P. Appell in the chair.—H. **Deslandres** and A. **Perot**: The design of an electromagnet capable of giving a magnetic field of 100,000 gauss. The limits of the magnetic field are imposed by the saturation of the iron and the heating of the bobbins. By a special method of cooling the bobbins and modifying their position with respect to the iron core the authors have already obtained a field of 51,500 gauss. For the proposed magnet, keeping the same concentration of ampere-turns, the copper used is to be pure, and strongly cooled petrol to be utilised to carry away the heat generated in the coil. On account of the large consumption of electrical energy it will be necessary to set up the magnet close to a large generating station to reduce the cost of the current. G. **Gouy**: The action of gravity on gaseous mixtures, notably in the terrestrial atmosphere. From a mathematical investigation it is concluded that the action of gravity on the composition of air is too slow to produce sensible effects except in the inaccessible region where the pressure is comparable with that in a Crookes tube.—Paul **Sabatier** and Léo **Espil**: The reduction of nickel protoxide and the existence of a sub-oxide. The reduction of oxide of nickel NiO by hydrogen has been studied at varying temperatures, the reaction being followed by weighing the water formed. Reduction is more readily effected on an oxide which has been formed at a low than at a high temperature, and an increase in the velocity of the current of hydrogen also increases the reduction. The velocity of reduction is an exponential function of the temperature. There are indications of the formation of a sub-oxide, Ni_4O; this is also reduced but at a slower rate than the original NiO.—P. E. **Gau**: General transformations of differential systems.—G. **Armellini**: The general theorem on the problem of n bodies.—Victor **Vâlcovici**: Hydrodynamic resistance in non-uniform movement.—Charles **Rabut**: The calculation of the forces developed by the contraction of cement in armoured concrete.—Th. De **Donder**: The kinematic interpretation of Poynting's theorem.—Louis **Benoist** and Hippolyte **Copaux**: The application of the laws of transparency of matter to the X-rays to the determination of some contested atomic weights. Cases of thorium and cerium. From the opacity to the X-rays the values 232 and 140 are found to be the most probable atomic weights for thorium and cerium respectively.—Georges **Claude**: The light yield of neon tubes as a function of their diameter.—B. **Szilard**: A radium lightning conductor. A small disc carrying a radium preparation is placed beneath the point of the conductor. The electrical effects observed with this in air are described.—H. **Parodi**: An arrangement of rings or brushes capable of replacing the collector in dynamos.—E. **Rothé** and R. **Clarté**: The influence of the state of the atmosphere on the propagation and reception of hertzian waves.—Mme. N. **Demassieux**: Study of the equilibrium between the chlorides of lead and sodium in aqueous solution.—Léon **Guillet**: The alloys of copper, nickel, and aluminium. Measurements of the elastic limit, breaking strain, hardness, and resilience of three sets of alloys containing 60, 83, and 90 per cent. of copper, and varying proportions of nickel and aluminium.—R. **Lespieau**: Passage from the dimethyl ethers of the acetylene glycols to the glycols.—E. E. **Blaise**: The formation of rings from the 1:4 diketones.—H. **Gault**: Oxalacetic ester.

—Georges **Dupont**: The stereochemical isomers of some γ-glycols.—Paul **Brenans**: Iodine compounds obtained from orthonitroaniline and orthonitrosulphanilic acid.—Const. A. **Ktenas**: Metamorphic phenomena at the island of Sériphos.—C. **Gaudefroy**: The dehydration figures of potassium ferrocyanide.—Louis **Matruchot**: Progressive cultural variations of *Tricholoma nudum*.—J. M. **Lahy**: The objective signs of fatigue in professions not requiring muscular effort. The variations in the blood pressure and reaction time were found to give useful indications of this class of fatigue.—Louis **Lapicque**: The economy in food realisable by raising the external temperature. A discussion of a recent note on this subject by Miramond de Laroquette.—E. **Voisenet**: New researches on a ferment contained in waters, the dehydrating agent of glycerol.—G. de **Gironcourt**: The milk ferments in the Touareg.—Paul **Bertrand**: Relations of the imprints of Corynepteris with Zygopteris.—E. **Bénévent**: Glacial action.—Ph. **Flajolet**: Observations made at the Lyons Observatory during the hurricane of February 22, 1914.—E. A. **Martel**: The Beatus-Höhle (Switzerland) and underground water of limestones.—De Montessus de **Ballore**: Luminous phenomena accompanying the earthquake at Rauhe Alb, November 16, 1911.

March 16.—M. P. Appell in the chair.—Ch. **Lallemand**: The twenty-four hours dial. For telegrams and railway time-tables numbering the hours from 0 to 24 has distinct advantages. In the author's opinion there is no advantage, however, in dividing the clock dial into twenty-four hours instead of the usual twelve.—A. **Haller** and Jean **Louvrier**: Syntheses by means of sodium amide. Preparation of some of the higher homologues of mono- and di-methyl camphors, as well as the corresponding camphols. The sodium amide method has been applied to the preparation of ethyl- and diethyl-camphor, methylethylcamphor, propyl- and dipropyl-camphor, benzyl- and dibenzyl-camphor and ethylbenzylcamphor. All these have been reduced to the corresponding camphols, the properties of which are described.—Paul **Sabatier** and M. **Murat**: The direct hydrogenation by catalysis of the diaryl ketones and the aryl alcohols. The preparation of polyaryl alcohols. Benzophenone is reduced by hydrogen in presence of nickel to diphenylmethane; with a more active nickel the reduction can be carried to di*cyclo*hexylmethane. The reaction, which is a general one, is shown to hold for the higher homologues of benzophenone.—Charles **Richet**: Hereditary tolerance of toxic substances in the lower organisms. The lactic acid ferment was grown in presence of toxic substances (potassium arseniate, phosphate, seleniate, nitrate), and after several successive cultures was found to acquire a resistance to the action of the toxic body present.—A. **Laveran** and G. **Franchini**: The infection of mice by means of the flagellæ of the rat flea by the digestive tract.—C. **Guichard**: Asymptotic networks and congruences.—J. **Guillaume**: Observation of the partial eclipse of the moon on March 11, 1914, made at the Lyons Observatory.—F. **Courty**: Observation of the eclipse of the moon of March 12, 1914, at the Bordeaux-Floirac Observatory.—Henry **Bourget**: Observation on the same made at Marseilles.—W. **Blaschke**: The evaluation of double integrals of convex functions.—R. **Jentzsch**: The extension of a theorem of Laguerre.—Henri **Frossard**: The whispering voice and in general the flow of a fluid under pressure in a capsulism going from zero to infinity.—Léon and Eugène **Bloch**: The spark spectra of nickel and cobalt in the extreme ultra-violet. Measurements are given for wave-lengths between 2100 and 1850.—J. de **Kowalski**: The different spectra of mercury, cadmium, and zinc. The metallic vapours were examined at different pressures, governed by the temperature of a piece of metal in a subsidiary quartz bulb. The discharge was produced without electrodes, by surrounding the quartz bulb containing the vapour with several turns of copper wire carrying a high-frequency current. The lines observed varied with the vapour pressure of the metal.—Jean **Timmermans**: Pure propane: the weight of a normal litre. Two sets of density measurements were made, the gas in the first set being prepared by Lebeau's method from propyl iodide and sodium amide, and in the second set by the reduction of propionitrile by sodium. The final purification in both cases was effected by fractional distillation. The mean result (seventeen observations) was 2·01955 grams per litre.—J. **Bancelin**: The absolute measurement of adsorption coefficients. The adsorption was studied on known areas of glass plates, and results are given showing the quantities adsorbed in grams per sq. cm. at different concentrations of the solution.—Eugène Louis **Dupuy**: The magnetic susceptibility of some feebly magnetic alloys. Alloys of silver and antimony, lead and tin, and zinc and aluminium were studied, and the results given graphically, the magnetic susceptibilities being taken as ordinates and percentage composition as abscissæ.—A. **Colani**: Ferrous and chromous metaphosphates.—Marcel **Dubard**: The relations of the principal genera of Mimusopeæ between themselves and with the Sideroxyleæ.—J. **Beauverie**: The chondriome of the Basidiomycetes.—G. **Kimpflin**: The laws of physical growth during childhood and adolescence. A continuous study of 200 children from the age of eleven to sixteen years. Relations between the height, weight, and thoracic perimeter.—L. and M. **Lapicque** and R. **Legendre**: Change in the excitability of nerves caused by an alteration in their myeline sheath. The action upon the nerve of the frog of chloroform, ether, cocaine, strychnine, sodium oxalate, solanine, and morphine is detailed.—A. **Magnan**: The characteristics of the marine birds.—Louis **Léger**: A parasite of the trout, belonging to genus Dermocystidium.—Edgard **Herouard**: Pædogenesic pæcilogony in *Chrysaora isoceles*.—Adrian **Lucet**: Researches on the evolution of *Hypoderma bovis* and the means of destroying it.—J. **Deprat**: The presence of the marine Rhætian with coal, on the western border of the delta of the Red River, Tonkin.—Paul **Fallot**: The stratigraphy of the Sierra of Majorca.—Ph. **Flajolet**: Perturbations of the magnetic declination at the Lyons Observatory (Saint-Genis-Laval) during the fourth quarter of 1913.

BOOKS RECEIVED.

The Marine Biological Station at Port Erin (Isle of Man), being the Twenty-seventh Annual Report of the Liverpool Marine Biology Committee. Pp. 70. (Liverpool: C. Tinling and Co., Ltd.)

Was Wir Ernst Haeckel Verdanken. Edited by H. Schmidt. Band i. Pp. xv+432. Band ii. Pp. viii+416. (Leipzig: Verlag Unesma G.M.B.H.) 2 vols., 8 marks.

Union of South Africa. Annual Report of the Department of Agriculture for the Period 1912–13 (Agricultural Education). Pp. 184. (Cape Town: *Cape Times*, Ltd.) 4*s*.

Ricerche Sperimentali Sui Raggi Magnetici in Diversi Gas e Miscugli Gassosi. By Prof. A. Righi. Pp. 36. (Bologna: Gamberiori e Parmeggiani.)

Wild Flowers as They Grow. Photographed in Colour Direct from Nature. By H. E. Corke. With descriptive text by G. C. Nuttall. Sixth series. Pp. viii+200+plates. (London: Cassell and Co., Ltd.) 5*s*. net.

Technical Mechanics: Statics and Dynamics. By

Prof. E. R. Maurer. Third edition. Pp. vii+356. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10s. 6d. net.

Laboratory Manual, Direct and Alternating Current, Prepared to Accompany Timbie's Elements of Electricity. By C. E. Clewell. Pp. vi+100. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4s. 6d. net.

Boden-Bakterien und Boden-Fruchtbarkeit. By Dr. F. Löhnis. Pp. vi+70. (Berlin: Gebrüder Borntraeger.) 1.20 marks.

La Silice et les Silicates. By H. le Chatelier. Pp. 574. (Paris: A. Hermann et Fils.) 15 francs.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part xv. (London: Gurney and Jackson.) 2s. 6d. net.

Sounds and Signs. By A. Wilde. Pp. 180. (London: Constable and Co., Ltd.) 4s. 6d. net.

The Currents in the Gulf of St. Lawrence. By Dr. W. Bell Dawson. Pp. 46+map. (Ottawa: Department of Naval Service.)

Kaiserliche Marine. Deutsche Seewarte. Aus dem Archiv der Deutschen Seewarte. xxxvi. Jahrgang 1913. Nr. 3. Die Temperaturschwankungen 1870–1910 in ihrem Verhaltnis zu der II jährigen Sonnenfleckenperiode. By J. Mielke. Pp. 63. (Hamburg.)

Igneous Rocks and their Origin. By Prof. R. A. Daly. Pp. xxii+563. (New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd.) 17s. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 26.

ROYAL SOCIETY, at 4.30.—The Nature of the Tubes in Marsupial Enamel and its Bearing upon Enamel Development: J. H. Mummery.—Oxidation of Thiosulphate by Certain Bacteria in Pure Culture: W. T. Lockett.—The Production of Anthocyanins and Anthocyanidins: A. E. Everest.—Variations in the Growth of Adult Mammalian Tissue in Autogenous and Homogeneous Plasma: A. J. Walton.—(1) The Decomposition of Formates by *B. coli communis*; (2) The Enzymes which are Concerned in the Decomposition of Glucose and Mannitol by *B. coli communis*: E. C. Grey.—Description of a Strain of *Trypanosoma brucei* from Zululand. I: Morphology. II: Susceptibility of Animals: Surg.-General Sir D. Bruce, Major A. E. Hamerton, Captain D. P. Watson, and Lady Bruce.

ROYAL INSTITUTION, at 3.—The Progress of Modern Eugenics. I: The First Decade, 1904–1914: Dr. C. W. Saleeby.

CONCRETE INSTITUTE, at 7.30.—*Discussion*: Calculations and Details of Steel-frame Buildings from the Draughtsman's Standpoint: W. C. Cocking.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8. Current Limiting Reactances on Large Power Systems: K. M. Faye-Hansen and J. S. Peck.

INSTITUTE OF CHEMISTRY, at 8.—Explosives: W. Macnab.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Illumination in Connection with the Textile Industries: L. Gaster.—Further Note on the Estimation of Prussian Blue in Textile Fabrics: H. E. Williams and W. P. Dreaper.

FRIDAY, MARCH 27.

ROYAL INSTITUTION, at 9.—Improvements in Long Distance Telephony: Prof. J. A. Fleming.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Harmonigraph as Applied to Advertising: A. Forbes.

FARADAY SOCIETY, at 5.—Discussion on Optical Rotatory Power.—Introductory Address: Prof. H. E. Armstrong.—Some Contributions to the Knowledge of the Influence of Certain Groups on Rotatory Power: Prof. H. Rupe.—New Studies in the Rotatory Dispersion of Tartaric Acid and Malic Acid: Prof. H. Grossman.—The Existence of Racemic Tartaric Acid in Solution: Dr. E. Darmois.—Anomalous Rotatory Dispersion: Prof. L. Tschugaeff.—Normal and Anomalous Rotatory Dispersion: Dr. T. M. Lowry and T. W. Dickson. At 8.15.—An Enclosed Cadmium Arc for Use with Polarimeter: Dr. T. M. Lowry and H. H. Abram.—The Relations between the Rotatory Powers of the Members of Homologous Series: Dr. R. H. Pickard and J. Kenyon.—The General Behaviour of Optically Active Compounds as Regards the Dependence of Rotation on Temperature Dilution, Nature of Solvent, and Wave Length of Light: Dr. T. S. Patterson.

PHYSICAL SOCIETY, at 5.—A New Type of Thermogalvanometer: F. W. Jordan.—An Instrument for Recording Pressure Variations due to Explosions in Tubes: J. D. Morgan.—The Direct Measurement of the Naperian Base: R. Appleyard.—An Experiment with an Incandescent Lamp: C. W. S. Crawley.

SATURDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

ESSEX FIELD CLUB (at the Essex Museum, Romford Road, Stratford), at 6.—Some Notes on Essex Geology at the Close of the Nineteenth Century and After: W. Whitaker.—Wasps and their Ways: C. Nicholson.

MONDAY, MARCH 30.

ROYAL SOCIETY OF ARTS, at 8.—Surface Combustion: Prof. W. A. Bone.

INSTITUTE OF ACTUARIES, at 5.—The Treatment of the Depreciation in Assets due to an Enhanced Rate of Interest: R. R. Tilt.

TUESDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—Landscape and Natural Objects in Classical Art: Later Greece and Rome: A. H. Smith.

ROYAL SOCIETY OF ARTS, at 4.30.—The Oil Resources of the Empire: D. F. Mollwo Perkin.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Some Recent Developments in Commercial Motor-vehicles: T. Clarkson.—Comparative Economics of Tramways and Railless Electric Traction: T. G. Gribble.

WEDNESDAY, APRIL 1.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Damage Caused to Vegetation by Sulphrous and Sulphuric Acids in the Atmosphere: R. R. Tatlock and R. T. Thomson.—Abnormal Refraction of Milk Serum: Dr. J. McCrae.—Water of Dorton Spa: C. A. Mitchell.

AERONAUTICAL SOCIETY, at 8.30.—Aeroplanes. G. de Haviland.

ROYAL SOCIETY OF ARTS, at 8.—Sarawak: Her Highness The Ranee of Sarawak.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, APRIL 2.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Series Lines in Spark Spectra: Prof. A. Fowler.

ROYAL INSTITUTION, at 3.—The Progress of Modern Eugenics. II. Eugenics To-day: Its Counterfeits, Powers, and Problems: Dr. C. W. Saleeby.

CHILD STUDY SOCIETY, at 7.30.—The Nervous Child: Dr. L. Guthrie.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Signalling of a Rapid Transit Railway: H. G. Brown.

FRIDAY, APRIL 3.

ROYAL INSTITUTION, at 9.—Further Researches on Positive Rays: Sir J. J. Thomson.

INSTITUTION OF CIVIL ENGINEERS at 8.—East Stirlingshire Waterworks, and a Note on Earthen Embankments: O. I. Bell.

SATURDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

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THURSDAY, APRIL 2, 1914.

THE SYRIAN GODDESS.

The Syrian Goddess; Being a translation of Lucian's "De Dea Syria" with a Life of Lucian. By Prof. H. A. Strong. Edited with notes and an introduction by Dr. J. Garstang. Pp. xiii+111. (London: Constable and Co., 1913.) Price 4s. net.

In view of recent excavation upon sites in Syria, and of the increased interest the ancient cults of that region have for the archæologist, it was well worth while to produce an annotated edition of the well-known treatise "De dea Syria." The editors accept the traditional ascription of the work to Lucian, and there is much to be said for this view; for, although the rest of Lucian's works are written in pure Attic Greek, he may well in his early youth have adopted the Ionic dialect for this treatise in imitation of Herodotus. We should then assign its composition to the middle of the second century B.C. In any case, the record is that of an intelligent traveller who is anxious to make known the facts he has been able to ascertain as to the strange Oriental rites of Syria, and as such it has the very greatest value for the archæologist. Its author describes the cult and temple of the goddess of North Syria, Atargatis, and that of her male consort, at Hierapolis, near Mumbij, on the Euphrates. It has long been recognised that Atargatis was a combination of the Cilician goddess Atheh with Athar, the Aramaic form of the goddess Astarte or Ishtar.

In his introduction Prof. Garstang would trace her descent from a still more remote antiquity, connecting her with the chief goddess of the Hittites, the great nature-mother who appears in the Anatolian rock-sculptures. One of the earliest of her images may well be that mysterious and gigantic figure carved in the living rock on Mount Sipylus, near Smyrna. The fact that Atargatis of Hierapolis is always represented as robed upon coins from the site is in favour of the Hittite comparison; and the descent of her consort from the Hittite and Mitannian weather-god Teshub is rendered probable by the fact that the author of the treatise, "De dea Syria," identifies him with the Syrian Adad. Thus it may well be that much of the cult the author describes had been inherited from the ritual of the Anatolian deity as practised fifteen centuries before he wrote.

Prof. Garstang's notes and introduction give evidence of wide reading in the course of his study of this interesting theme, and the book will form a useful supplement to the collection of material he has already published in his larger work on "The Land of the Hittites." L. W. K.

STONES AND SUPERSTITIONS.

The Curious Lore of Precious Stones. By Dr. G. F. Kunz. Pp. xiv+406+63 plates, and numerous illustrations in the text. (Philadelphia and London: J. B. Lippincott Company, 1913.) Price 21s. net.

Dr. Kunz's wide knowledge and experience in connection with precious and semi-precious stones, and his familiarity with the voluminous literature dealing with the subject, afford a sufficient guarantee to all interested in gems and their "curious lore," that the work he has now produced is one of exceptional value. On the title-page of this handsome volume the subjects to be dealt with in relation to gems are enumerated as "their sentiments and folk-lore, superstitions, symbolism, mysticism, use in medicine, protection, prevention, religion, and divination, crystal-gazing, birth-stones, lucky stones, and talismans, astral, zodiacal, and planetary"—and this long list is far from exhausting the mass of extraordinary and fanciful ideas treated of in the book, and constituting one of the strangest illustrations of human credulity and love of the marvellous.

With regard to the disputed question as to whether precious stones first came to be prized as ornaments or talismans, our author does not attempt to give a decision; he justly points out that the absence of precious stones in the oldest known interments, where shells, etc., appear to be used as ornaments, may be accounted for by the hardness of the stones which prevents easy perforation. Jet ornaments, however, occur with Palæolithic remains, both in the caves of Belgium and Switzerland, and harder stones are found in Neolithic graves. Of the early use of stones as fetishes there is no doubt; life, sex, powers of reproduction, and many extraordinary virtues and influences were ascribed to them at the dawn of history. Magic formulæ concerning stones are found alike in the clay tablets of Sumero-Assyrian age and in Egyptian papyri of very early date. The earliest engraved cylinders of Babylon are ascribed to 4000 B.C., and scarabs of Egypt to 2000 B.C., while amber was found in abundance in the graves of Mycenæ. In classical times magical influences were ascribed to the beautifully engraved gems, partly on account of the materials of which they are composed, and partly from the figures and inscriptions which they bore, and when in medieval times the art of gem-engraving was lost, the gems were still made serviceable by the representations of Greek deities being regarded as those of Christian saints, liturgies being composed by means of which—the old love of ornament and mysticism remaining—the heathen relics were reconsecrated for Christian use.

Of the persistence to recent periods, and even to our own day, of fanciful and superstitious beliefs concerning precious stones, Dr. Kunz gives many amusing illustrations. In a book published in Frankfort as late as 1718, an "airship" is represented which is raised by the supposed action of sunlight upon the "coral-agates" in its roof, a "magnetic action" being thus produced! Napoleon, when in Egypt, found a carnelian seal engraved with Arabic characters, which he wore as a talisman until his death, and it was equally treasured and carried at all times by Napoleon III. The ill-fated Prince Imperial had it on his person in South Africa, and it appears to have been carried off by the Zulus who stripped his body. It is asserted that a well-known noble lady, still living, believes that her diamonds not only have life and sex, but are capable of reproduction; while a recent trial in Paris showed that a wealthy lady became suddenly so overcome by fear of the evil influences of an opal-ring she wore that she slipped it off and put it on the finger of a poor girl who was passing. It is declared that a well-known authoress confesses that she habitually resorts to "crystal-gazing" to recover the thread of a story that she has temporarily lost.

Many very interesting extracts are given by Dr. Kunz from curious and little-known works, which illustrate alike the wildly absurd views held in all ages concerning the various influences exercised by different precious stones on those who wear them, and the cures and other wonders wrought by them, these ideas prevailing not only among the poor and ignorant, but among the educated of all classes and religions. The book, which is admirably illustrated, is as entertaining as it is instructive.

J. W. J.

ANIMAL MORPHOLOGY AND EMBRYOLOGY.

(1) *A Text-book of General Embryology.* By Prof. W. E. Kellicott. Pp. v + 376. (New York: Henry Holt and Co., 1913.) Price 2.50 dollars.

(2) *Zellen- und Gewebelehre Morphologie und Entwicklungsgeschichte.* Unter Redaktion von E. Strasburger und O. Hertwig. Bearbeitet von E. Strasburger, W. Benecke, R. Hertwig, and others. I. Botanischer Teil. Unter Redaktion von E. Strasburger. Bearbeitet von E. Strasburger und W. Benecke. Pp. vii + 338. Price 10 marks. II. Zoologischer Teil. Unter Redaktion von O. Hertwig. Bearbeitet von R. Hertwig, H. Poll, O. Hertwig, and others. Pp. vii + 538. (Berlin and Leipzig: B. G. Teubner, 1913.) Price 16 marks.

(3) *Elementares Praktikum der Entwicklungsgeschichte der Wirbeltiere mit Einführung in die Entwicklungsmechanik.* By Dr. Oscar Levy. Pp. viii + 183. (Berlin: Gebrüder Borntraeger, 1913.) Price 5.60 marks.

(1) THIS is an excellent book to place in the hands of intermediate students of zoology; it gives a clear and interesting account of the more general aspects of embryological science. If the hypercritical reader regards it as somewhat scrappy and superficial, it must be answered that this is unavoidable in a book of its size dealing with so large a subject. The book does not pose as a work of reference; its function rather appears to be to give the student an idea of the present-day point of view of biologists towards the various problems of which it treats, to arouse his interest, and to direct his steps towards the fuller expositions to be found in contemporary literature.

An introductory chapter upon ontogeny is followed by excellent chapters on the cell and cell-division, the germ cells, and the process of maturation or meiosis. In regard to the last-mentioned phenomenon a very good and clear account of modern views is given. A few obvious slips will, no doubt, be corrected in a new edition, *e.g.*, in the legend attached to Agar's figure illustrating the spermatogenesis of Lepidosiren the last six words convey an erroneous statement, and should be excised. Again, in the description of tetrad formation the student will be liable to be puzzled, if not misled, by the wording of the statement that "each of the newly-organised bivalent elements comes out in the form of four small bodies, the tetrads." He may find himself in a similar position when he reads that in cases where tetrad formation takes place "the secondary spermatocytes have the diploid number." Good accounts are given of fertilisation, and of the general features of segmentation, including "cell-lineage," and these are followed by an excellent chapter on the differentiation of the embryo, heredity, and sex determination. In this chapter we welcome particularly the short and clear and critical account of the hypothesis of "organ-forming substances," which will act as a useful corrective to the somewhat prevalent teaching of this hypothesis by uncritical teachers as a well-established theory. As the author puts it, the localised distribution of substances in the egg, upon which this hypothesis is based, is to be regarded rather as a process or result of development than as a primary determining factor of the course of development. A good account is given of the idiochromosome and its relation to sex, and the book ends with a chapter on blastula, gastrula, and germ-layers.

The book is excellently written, and clearly illustrated; it fills an obvious gap in the teaching literature of zoology, and it deserves to have a wide circulation amongst students of that science.

(2) The two biological volumes here under discussion fully maintain the high standard of the great series of volumes entitled "Die Kultur der Gegenwart." The botanical volume is composed of an excellent section on plant histology from the pen of the late Prof. Strasburger, followed by one on plant morphology and development by Benecke.

The zoological volume forms an interesting text-book which will be of use to the senior student as a help towards getting a grip of the current views regarding some of the more important problems of morphology. The volume opens with a charming essay by Richard Hertwig upon unicellular organisms, which gives an excellent sketch of present-day ideas, together with valuable indications regarding future work. Hertwig's essay is followed by a useful sketch of modern histology by Poll, and this in turn by an admirable chapter by Oscar Hertwig on general and experimental morphology and embryology. This commences with a masterly account of the main features of gametogeny and fertilisation—one of the most interesting sections being that in which is given an account of recent experiments in which gametes or zygotes have been subjected to the influence of such substances as radium and mesothorium. An excellent chapter is devoted to parthenogenesis, and the suggestion is brushed aside with scant ceremony that the production of parthenogenesis by artificial means — whether chemical or mechanical—gives any clue whatever to the ultimate nature of the fertilisation process. A witty paragraph is quoted from Bolzmann as to Loeb's work and the exaggerated claims based upon it. How important was the discovery that a process believed to be so essentially vital in its nature was merely chemical! What important consequences the discovery might have when future developments rendered possible its application to the human race—the emancipation of woman to a degree undreamt of by the greatest enthusiast for women's rights! The mere man becomes superfluous; he is replaced by a flask of chemical solution; sex-determination by chemical means follows, and males, now mere useless curiosities, are produced only as occasional specimens for zoological gardens!

A general description is given of the processes of segmentation and gastrulation, and the chapter concludes with a short sketch of the chief results of experimental embryology.

About 150 pages are occupied by a really admirable account by Heider of the morphology of the invertebrate metazoa. It is most clearly and interestingly written, and is illustrated by excellent figures. Naturally, views are occasionally expressed to which some may take exception, but, on the whole, we know of no better general account of the morphology of invertebrates. The subject-matter of the chapter is rightly termed morphology rather than comparative anatomy, confining itself as it does to really important features and ignoring those masses of unimportant detail that so usually make a modern text-book of zoology an effective stifler of all interest in the subject. We notice very few slips. The familiar German misuse of the word splanchnopleure when splanchnic mesoderm is meant catches the eye of the English reader. The frequent reference made to the trochosphere type of larva as an evidence of phylogenetic affinity will not altogether appeal to those who suspect the various larvæ of this type of being simply convergent adaptations to a pelagic existence, while some morphologists of the Cambridge school will look askance at the not unfamiliar attitude towards the primitive and ancestral nature of the lower platyhelminths. But the general opinion will be that Heider has produced a very admirable sketch of his subject.

The remaining two chapters—on vertebrate embryology by Keibel and on vertebrate morphology by Gaupp—are less satisfactory. It seems an error in planning the book to have two such separate chapters, as there can be no morphology worth the name without embryology, and no embryology worth the name without morphology. We are glad to see that Keibel is not overawed by the sanctity of that—in some respects—most highly specialised vertebrate Amphioxus, and that he takes the common-sensible position in regard to the greatly degenerate character of its head region, though we fail to follow him in his somewhat derogatory remarks regarding its gastrulation processes. It seems, by the way, regrettable that Keibel, like many others who are specially interested in the embryology of the higher vertebrates, uses the word gastrulation in a sense which does not seem to be justified. Strictly speaking, the term gastrulation should only be used of forms in which an undoubted gastrula has been shown to be present; to use it in reference to the two-layered condition of a bird or mammal in which there is the greatest reason to doubt that a true gastrula stage exists at all, is simply to court confusion, and leads to such absurdities as the statement that "endoderm," or "ectoderm," is not homologous throughout the series of vertebrates. To give a cell-layer, the name endoderm in the various types of vertebrates is, of course, merely a short way of stating that it *is* homologous in these various types!

(3) Dr. Levy's book affords a short sketch of vertebrate embryology written from a practical point of view. Simple instructions as to laboratory methods are given, stress being very properly laid on the preparation of thick, free-hand sections of embryos—the great instructiveness of which is too often ignored. The chapter on technique is followed by an account of gametes and gametogenesis, then by chapters on early development in amphibia and in the chick, while the remaining half of the book is devoted to organogeny and a short chapter on developmental mechanics.

OUR BOOKSHELF.

The Change in the Climate and its Cause. By Major R. A. Marriott. Pp. 94. (London: E. Marlborough and Co., n.d.) Price 1*s.* 6*d.*; cloth 2*s.* 6*d.*

THIS book is a contribution to the great Drayson Myth, and as such it may appeal to those with whom it is a fair presumption that any theory of orthodox science is wrong, and also to those who take a curious interest in the vagaries of that class of mind.

Major Marriott, like Sir A. de Horsey in "Draysonia," complains that Drayson was not taken seriously. The fact is perfectly true, but the complaint is unjust precisely because General Drayson (not without professional precedents) failed to take seriously the position he was assailing. Astronomy is unique among sciences in its dependence on a single controlling principle, gravitation. It is open to anybody to abolish that principle and coordinate the facts otherwise—if he can. Or he may question the accuracy in detail of a mathematical deduction or demonstrate a false assumption. What he cannot do is to isolate a piece of the whole doctrine, reject the operation of the general law in the particular case on insufficient grounds, and ignore the effect of what he is doing on the whole related theory.

It would be unprofitable to comment on the errors (as we deem them) of the present work. It is pleasanter to mention the one pertinent remark which we have come across. This is the reference to the theory of "planetary inversion" (p. 66). It is quite possible that tidal friction is slowly changing the obliquity of the ecliptic, and thus exercising a secular influence on climate. But the effect is very slow; it is not periodic; and there is little in common between the methods of Mr. Stratton and those of General Drayson and his followers.

The book deals largely with changing climatic conditions, the evidence of geology, and the bearing of the so-called astronomical theory of an ice age. But why are the possibilities limited by the tacit assumption that the radiation of the sun has been constant through geological ages, an assumption not merely unproved, but even improbable? H. C. P.

Perspective made Easy by Means of Stereoscopic Diagrams. By C. E. Benham. (Colchester: C. E. Benham, 28 Wellesley Road.) Price (post free) 6*s.* 2*d.*

THIS set of fifteen stereograms is intended as a substitute for models as used by teachers and students in illustration of some of the rules and principles of perspective projection. When viewed in a stereoscope the diagrams exhibit in relief, amongst other things, the principle of the convergence or parallelism of the projections of parallel lines in space; and the rotation into the picture plane of horizontal and vertical vanishing planes, thus illuminating the constructions relating to vanishing and measuring points for horizontal and inclined lines. An explanation is given in a sixteen-page pamphlet which accompanies the stereograms.

The idea of the author is good, but it is not very efficiently carried out. The views are not always so convincing as they might be, and the descriptions are occasionally lacking in mathematical precision. We also think that the price has been fixed too high. Nevertheless, a teacher would receive some useful suggestions by a study of the diagrams.

A Laboratory Manual of Organic Chemistry for Beginners. By Prof. A. F. Holleman. Edited by Dr. A. J. Walker. Second edition, partly re-written. Pp. xvii+83. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 4*s.* 6*d.* net.

A REVIEW of the first edition of Dr. Walker's translation of Prof. Holleman's little book appeared in the issue of NATURE for May 11, 1905 (vol. lxxii., p. 28). New experiments have been incorporated in the present edition, and some obsolete reactions have been omitted.

Engineering Workshop Exercises. By Ernest Pull. Pp. viii+80. (London: Whittaker and Co., 1914.) Price 2*s.* net.

THIS little book provides instructions to enable technical students and apprentice engineers to perform their workshop experiments and exercises intelligently, and to obtain practice in the use of ordinary engineering tools and appliances. Prominence is given to the value of working drawings, and accuracy is insisted upon consistently. A chapter on screw-cutting and notes on materials are included in the book.

LETTERS TO THE EDITOR.

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

The Doppler Effect and Carnot's Principle.

IN my letter of March 19 I endeavoured to show that the latent heat absorbed in the production of unit volume of stationary vibration of a particular frequency in a mixed beam of radiation, is not equal to $4q/c$ (where q is the energy stream per sq. cm. per sec., and c the velocity), as would naturally be supposed, but, in consequence of the Doppler effect at the moving mirror or piston, takes the form $T(dp/dT)$, as required by Carnot's principle, where p is the pressure, or the mechanical work per unit volume, and is equal to $2q/c$ for a directly reflected beam under equilibrium conditions. The latent heat, $T(dp/dT)$, may be represented as the sum $(u+p)$ of the intrinsic energy or internal latent heat u and the external work p. As a matter of interpretation, u was identified in my letter with some form of stationary vibration which continued to exist in the medium at the frequency at which it was emitted. Further analysis shows that this is not the case, but that the energy left in the medium conforms exactly to the distribution required by the theory of exchanges. The energy density is $2q/c$ in a directly reflected beam, and is equal to the pressure, but differs from the energy absorbed on emission or evolved on condensation, namely, the latent heat, $T(dp/dT)$, which is the quantity measured experimentally, as previously explained (*Phil. Mag.*, October, 1913, p. 787).

Similarly in the case of full radiation where the energy stream is Q per sq. cm. per sec. in all directions, the energy density is $4Q/c$, and the pressure $4Q/3c$ *for each frequency*, but the latent heat per unit volume is still $T(dp/dT)$ (in place of $16Q/3c$) on account of the Doppler effect, and the energy stream *as measured experimentally* is not Q but $\frac{1}{4}T(dQ/dT)$. With a slight change of viewpoint the consideration of the Doppler effect leads to the exact formulæ and numerical relations already detailed in my previous note (*loc. cit.*), which are now seen to be no longer in conflict with the electromagnetic theory as was at first supposed. H. L. CALLENDAR.

Imperial College of Science, South Kensington,
March 30.

Lead and the Final Product of Thorium.

IT is now practically certain that the final product of the uranium family of radio-elements is isotopic, or chemically identical, with lead. The constancy of the ratio between lead and uranium, Pb/U, in the case of primary rock-forming minerals of the same geological age, and its sympathetic variation in the case of minerals of different ages, go far to establish this important conclusion. The recent discovery that all the final products of radio-active disintegration fall into Group iv. B of the periodic classification has naturally led to the further suggestion that each one is isotopic with lead.

If lead, or one of its isotopic equivalents, is the final product of the thorium series, then the estimates of geological time hitherto based on the lead-uranium ratio stand in need of a ruthless revision.

Fortunately this does not appear to be necessary, for mineralogical evidence clearly indicates that the presence or absence of thorium in a uranium-bearing mineral does not affect the lead content, which can generally be adequately accounted for by the uranium alone.

It is easy to calculate the relative rates at which uranium and thorium generate their final products, and assuming that the latter are isotopic, to express a given amount of thorium in terms of uranium, and so to arrive at a "total equivalent quantity of uranium," U_e, which also takes thorium into consideration. If then lead is, chemically speaking, the final product of thorium as well as that of uranium, the ratio Pb/U_e ought to be constant for minerals of the same age, and ought to vary in sympathy with the ages if these should differ. I have examined a large number of analyses of radio-active minerals from this point of view, and neither of the above criteria is found to hold. In many cases a large percentage of thorium may be present, but unless uranium is also present, lead is nearly always absent. In the few examples where lead and thorium occur alone, the ratio Pb/Th is variable and bears no relation to the geological age of the minerals.

However, more fully to demonstrate the bearing of evidence of this kind on the problem, Mr. R. W. Lawson, of the Radium Institute, Vienna, and myself are at present estimating the thorium content of a series of Norwegian minerals of Devonian age which had already been analysed for lead and uranium (Proc. Roy. Soc., A, vol. lxxxv., p. 248, 1911). Other workers are busily engaged on determinations of the atomic weights of the lead from uranium and thorium bearing minerals respectively, and there is therefore some likelihood in the near future of a final settlement of the question whether lead is an end-product of thorium or not. ARTHUR HOLMES.

Geological Department, Imperial College of
Science, London, March 18.

Thermions and the Origin of Solar and Terrestrial Magnetism.

PREVALENT opinion seems to favour decidedly the hypothesis that the chief part of the magnetism of the earth or sun is due to the rotation of all, or a considerable portion of, the matter of which it is constituted. Theories of the magnetisation of matter by rotation fall into two classes: one (a) assuming that the substance is magnetic but not necessarily charged, the other (b) assuming that the substance is charged but not necessarily magnetic.

(a) If the matter is magnetic, consisting of molecular systems with individual magnetic moments differing from zero, rotation about a given axis will, on the electron theory, produce a torque on each individual system, causing it to contribute a magnetic moment parallel to the axis of rotation, and thus magnetising the whole body, if originally neutral, along this axis.

(b) Gravitation, or electrical forces, acting differentially on the positive and negative constituents of the matter, or differential centrifugal action, or some other cause, may give rise to a volume-density of electrification throughout the mass of a rotating body, in which case magnetisation, or at least a magnetic field, must result from the convection currents thus formed.

The particular kinds of differential action just mentioned have been proposed before, but I have seen no reference to the fact that an essentially steady electric volume-density must long ago have been produced by the emission of negative electrons from the heated matter of which the earth and sun are composed, and the resulting internal electric field. As the emission increases with the temperature, which increases from the surface inward, it is clear that the volume-density must be of the proper size to account for the polarity of solar and terrestrial magnetism.

It seems probable that both classes of effects are involved in the actual magnetisation in question, though experiment has shown that any effect of class (*a*) is at least exceedingly minute unless the magnetic behaviour of the interior parts of the earth and sun is quite different from that of matter at ordinary temperatures on the surface of the earth.

S. J. Barnett.

The Ohio State University, Columbus, Ohio, U.S.A., March 12.

A Triangle that gives the Area and Circumference of any Circle, and the Diameter of a Circle equal in Area to any given Square.

It is not possible to measure *exactly* the interminable fraction required for the line BZ in the following figure, but it is quite easy to draw it so nearly that the error is practically immensurable.

First Method.—Draw a line AB = 44, and make BZ = 23. $\frac{23}{44} = 0\cdot52\dot{2}\dot{7}272$, which is a little too long.

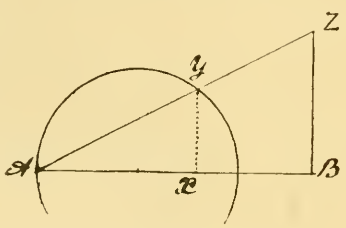
AY will then be short, about 1 in 600,000.
AX will also be short, about 1 in 300,000.

Second Method (with the familiar ratio $\frac{355}{113}$). Make a circle with diameter AB = 11·3, and let AX = $8\frac{7}{8}$. Draw a perpendicular from X to cut the circle in Y. Join AY, and continue the line to Z.

Then the error in AX, the $\frac{1}{4}$ circumference, will be less than 1 in 11,780,000 *in excess*.

The true angle for the line AZ lies between the lines found by the two methods, but the difference is too small for measurement, and in any accurate drawing the lines will appear to coincide.

AX being found, equal to an arc of 90°, a line for any other arc may be found; and the triangle once drawn on a sufficiently large scale, is true for all circles.



Let AB = 1, and at right angles BZ = 0·5227232008+, join AZ } Angle A. 27° 35′ 49·6″+

Then, any circle with diameter upon AB and one extremity at A, will cut the line AZ (or AZ produced) in a point Y, making AY the side of a square equal in area to the circle.

Also, a line from Y perpendicular to AB will cut the diameter in a point X, making AX equal to $\frac{1}{4}$ circumference of the circle.

Again, any square with base upon AB and a corner at A, will, with its side opposite to A, cut AZ in a point Y, making AY the diameter of an equal circle.

T. M. P. Hughes.

5 The Croft, Tenby.

The following remarks may help to explain Mr. Hughes's constructions:—

Let AY be a chord of a circle of which AD is a diameter, and let $\angle DAY = \theta$. Then if the square on AY equals the area of the circle, $(2r\cos\theta)^2 = \pi r^2$, and therefore $\cos^2\theta = \pi/4$, $\tan^2\theta = (4-\pi)/\pi$, and

$$\tan\theta = 0\cdot5227232,$$

very nearly, as stated. Now if we express this approximate value of $\tan\theta$ as an ordinary continued fraction we find the successive convergents,

$$1/1,\ 1/2,\ 11/21,\ 12/23,\ 23/44,\ \text{etc.},$$

where the first of those not written has four digits in numerator and denominator. Hence, as Mr. Hughes has discovered, 23/44 is a very close approximation to the transcendent number $\sqrt{(4-\pi)}/\sqrt{\pi}$. It seems absurd to speak of a mathematical accident, but we do seem to have something of the kind here. Supposing that a/b is a rational approximation to $\sqrt{(4-\pi)}/\sqrt{\pi}$, we should not expect beforehand a solution correct within about $4\cdot10^{-6}$ for values of a, b, each less than 100.

The second construction is obtained by putting, as an approximation,

$$AX : AD = \pi/4 = 355/4\cdot113 = 710/8\cdot113 = 8\tfrac{7}{8}/11\cdot3.$$

It would be easy to make a set-square with its shorter sides in the ratio 23 : 44, and this could be used for the approximate quadrature and rectification of any given circle. It is interesting to see how the same figure solves both problems to the same degree of exactness (practically). I suppose the error in the set-square could be reduced to 0·1 per cent., or less; the question is, what percentage of error is likely to occur in using it. For the rectification we have to draw the perpendicular YX; it seems to me that for the quadrature we are likely to obtain the most accurate results by using a straight edge as well as the set-square; that is to say, we should not try to adjust the set-square without first placing a straight edge along a diameter of the circle. If this is so, the graphical solutions of both problems are likely to be affected by the same percentage of error; because to obtain X, after marking Y, we have only to slide the set-square along the straight edge until a shorter side goes through Y; and if we repeat the manipulation several times, I do not think the error in finding X, regarded as a distance from the true position, can be so much as five times the error in finding Y, or conversely. Of course, by "the same percentage of error" I mean here that the two errors, on the same scale, are of the orders $\pm a\cdot10^{-n}$, $\pm b\cdot10^{-n}$, where a, b both lie above 1, while neither of them is equal to, or exceeds, 5.

G. B. Mathews.

New Units in Aerology.

With reference to Prof. McAdie's letter in Nature of March 19, p. 58, I should like to point out that throughout my "Thermodynamics," published in 1878, a megadyne per square centimetre is used as the unit of pressure, and it is termed a c.g.s. atmosphere. Ever since 1888, when the B.A. committee (of which I was a member), adopted the barad, I have employed in my lectures the above pressure unit under the name of megabarad. The corresponding unit of work, and also of heat, adopted in the book is the megalerg. Megerg to my ear is too cacophonous for use.

Robert E. Baynes.

Christ Church, Oxford, March 25.

PROGRESS IN WIRELESS TELEPHONY.

The attention of telephonic engineers has of late years been very closely directed to the improvement of the line wire in ordinary telephony. Apart from the imperfections of the telephone transmitter and receiver, *per se*, a very considerable effect is produced on the transmitted speech by the line itself if it is at all long. This action, from an electrical point of view, consists in the distortion of the wave form of the current as it travels along the cable, and its rapid attenuation or diminution in amplitude.

When speech is uttered to the mouthpiece of the transmitter, the current flowing into the line is modulated in a complicated manner, but this variation in virtue of Fourier's theorem can be analysed into the sum of a number of currents of simple harmonic or sine wave form placed in certain relative phases and having certain amplitudes. The velocity W, with which any simple harmonic current travels along a cable having a resistance R ohms, an inductance of L henrys, a capacity of C farads, and a dielectric leakance of S mhos per unit of length, provided that the quantities R/pL and S/pC are small compared with unity, can easily be shown to be expressed by the formula:—

$$W=\frac{1}{\sqrt{CL}}\frac{1}{\sqrt{1+\frac{1}{p^2}\left(\frac{R}{2L}-\frac{S}{2C}\right)^2}},$$

where $p=2\pi$ times the frequency.

Accordingly, the greater the frequency, the greater will be the wave velocity. In other words, short waves travel faster than long. The short waves, having also the least energy, attenuate most rapidly.

The result of this is that in the case of telephony along wires the different harmonic constituents of the current get out of step, and degrade unequally. Hence the wave form, and the quality of the received sound, is altered after the wave has travelled a certain distance along the wire or cable. The result is to diminish the loudness and reduce the clearness of the speech heard. Therefore, beyond a certain distance the articulate sound becomes unintelligible.

On the other hand, it is well known that the velocity of electromagnetic waves through space is independent of the wave length, and there is, therefore, in this respect a marked difference between the transmission of electromagnetic waves guided along wires, and free electromagnetic waves diverging through space. As soon as the telephonic or aural method of receiving Morse signals in wireless telegraphy was substituted for the method of employing some form of coherer as a relay to actuate a Morse inker printing them in *dot* and *dash* on paper tape, the suggestion was made that it might be possible to transmit articulate speech by space electromagnetic waves, and not merely Morse signals composed of long and short sounds; and hence to conduct a wireless or lineless telephony.

It was at once recognised that before this could be done it would be necessary to provide a generator of electromagnetic waves giving truly continuous waves, and not merely intermittent groups or trains of rapidly decadent waves. The discovery of the power of the continuous current arc between carbon electrodes to create high-frequency oscillations in a condenser circuit connected between the carbons, held out hopes of making such a generator. It was not, however, until Poulsen discovered the peculiar properties of an electric arc formed in hydrogen or coal gas to enable very high-frequency oscillations to be so generated that progress began to be made. The Poulsen arc-generator consists, as is well known, of a direct-current arc formed with an electromotive force of about 500 volts between a carbon and a copper electrode in an atmosphere of hydrogen or coal gas. A strong transverse magnetic field is also applied to the arc. An inductive circuit, consisting of a coil of wire having in series with it a capacity, the capacity and inductance being so adjusted that the natural frequency of this oscillation circuit is not less than about 50,000, or preferably much higher, even up to 250,000, is then connected between the carbon and copper electrodes. Powerful continuous electric oscillations are then set up in this condenser circuit. These oscillations can be made to set up similar oscillations in an open radiative circuit or antenna, which is inductively connected with the condenser circuit, as in the case of an ordinary wireless telegraph transmitter.

In this manner continuous or uninterrupted electric waves of a wave length which is anything between 1 and 4 or 5 miles, can be radiated from the aerial wire. The reason the hydrogen or coal gas is effective in enabling the arc to create more powerful high-frequency oscillations is that it increases the steepness of the characteristic or volt-ampere curve of the arc, and hence increases the energy which is conveyed to the condenser at each oscillation.

To transmit speech we have then to modify the amplitude of these radiated continuous electric waves sent out from the sending station antenna in accordance with the wave form of the speaking voice. This is done usually by some form of carbon microphone inserted in the base of the sending station antenna. When the diaphragm of the microphone is acted upon by the voice, the carbon granules in it are more or less compressed, and the electrical resistance thereby altered. If then the high-frequency current in the antenna is made to pass through this microphone, the amplitude of the radiated continuous waves will be varied by making speech to the microphone, in such a way as to create waves upon waves, or to alter the wave amplitude in accordance with the wave form of the speaking voice.

At the receiving end all the arrangements are identical with those required in wireless telegraphy when using a telephone and rectifier of some kind to receive audible Morse signals. The receiving antenna is coupled to a closed condenser circuit, and to the terminals of this condenser is attached a Bell receiving telephone in circuit with some oscillation rectifier, such as a crystal or constant detector, viz., carborundum, perikon, or zincite-chalcopyrite, or an ionised gas rectifier such as a Fleming glow-lamp valve. The telephone is then not affected by the rectified continuous oscillations *per se*, but it is affected by the variations in their amplitude produced by the microphone in the transmitter circuits.

Audible and intelligible speech can thus be reproduced at the receiving end. The limitations that present themselves in this transmission are wholly connected with the creation and modulation of the electric waves emitted by the sending station, and chiefly due to the difficulty of designing a microphone which can carry a sufficiently large current without heating. An additional trouble is that of devising a generator which shall be as simple and easily managed as that of a wireless telegraph plant.

As regards the microphone, most workers have employed a number of carbon microphones joined in parallel so as to enable a high-frequency antenna current of, say, 4 or 5 amperes to be passed through them without overheating any one. It is not easy, however, to divide the current equally between the microphones, or to keep them absolutely in step with each other. Another type is the liquid microphone of Majorana, and of Vanni. In Dr. Vanni's microphone a jet of water rendered slightly conducting by acid or salts is allowed to fall on a fixed inclined metal plate, B, and then bounces off on to another inclined metal plate, A, which is in mechanical or electrical connection with the diaphragm of a speaking mouthpiece (see Figs. 1 and 2). Speech, therefore, made to it sets the last-named plate vibrating, and thus breaks up and varies the resistance of the film or column of liquid connecting the two plates. Hence, if this liquid column is in the circuit of the transmitting antenna, any speech made to the diaphragm will vary the electrical resistance in the antenna circuit, and change in a similar manner the amplitude of the radiated electric waves.

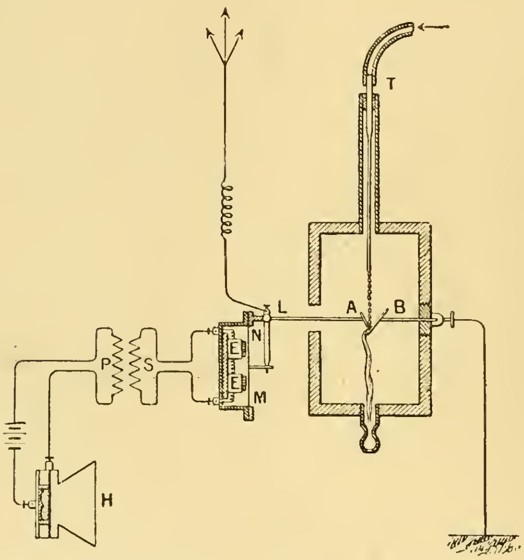


FIG. 1.—The liquid microphone of Dr. J. Vanni.

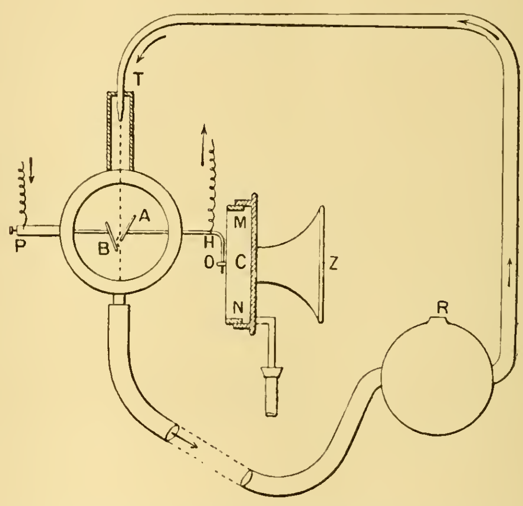


FIG. 2.—Arrangements for circulating the liquid by a rotary pump R in Vanni's microphone.

W. Dubilier has also invented a water-cooled carbon granule microphone, the main diaphragm being moved by the current through a relay microphone to which the speech is actually made. This microphone can pass 700 watts with clear articulation (see Fig. 3). Then with regard to generators, a good many modifications of the arc generator have been produced. The Moretti arc consists of a copper tube kept supplied with water, and another copper rod is brought down so as to strike the arc against the water. When the arc is formed with a continuous current, and is also shunted as above described with a condenser inductive circuit, high-frequency oscillations are set up in the latter. There is a very rapid extinction and re-ignition of the arc, possibly due to some action like that in the Wehnelt interrupter. The writer of this article has also devised recently a new form of arc generator which requires no transverse magnetic field, nor supply of hydrogen or coal gas, as in the Poulsen apparatus. We have, then, in addition, the high-frequency alternator method of creating the oscillations. Fessenden experimented at one time very largely with such machines, devising a form of Mordey alternator which could give a frequency of 80,000 or 100,000. The invention by R. Goldschmidt of a means of multiplying frequency by means of a rotating field alternator made a new departure. By this machine high-frequency continuous oscillations are mechanically created, and their amplitude can be controlled by a microphone placed in the exciting circuit of the machine, so that it is not traversed by the main current.

Furthermore, we have the high speed, smooth disc generator of Mr. Marconi as a means of creating undamped oscillations, and, in addition, a telephonic transmitter has been invented by him which has not yet been described in detail, but was mentioned by him in a recent lecture in Rome. It is known that he has recently directed his attention closely to invention in connection with wireless telephony.

It is also possible to employ spark discharges of a very high spark-frequency, above the limit of audition, as a means of creating what are practically unintermittent oscillations, the separate trains of oscillations being practically in contact with each other. This method depends upon the self-extinguishing power of electric arcs produced between certain metals which are good conductors, such as aluminium and copper. If a pile of plates of these metals with very small air-gaps is built up, and a high electromotive force applied to it, discharges will take place, or small arcs which, when the discharger is shunted by a condenser, can generate high-frequency oscillations. By the aid of these appliances, their inventors and other workers have conducted wireless telephony up to a distance of 1000 kilometres, or, say, five hundred or six hundred miles.

Thus, Dr. J. Vanni, working at Rome, and using a Moretti arc generator, his own liquid microphone, and a form of Fleming oscillation valve as a receiver, has transmitted and received articulate speech between Rome and the Island of Ponza (120 km.), to Maddalena (260 km.), to Palermo (420 km.), to Vittoria (600 km.), and finally between Rome and Tripoli, a distance of 1000 km.

The speech is said to have been clear and singularly free from evidence of distortion of wave form. In addition to this, successful experiments in wireless telephony are said to have been conducted between Berlin and Vienna, a distance of 375 miles, by the Telefunken Company. The stations were the German high-power station at Nauen, to the west of Potsdam, and a receiving station on the roof of the Technological and Industrial Museum at Vienna. The experiments were so promising that it is expected much greater distances can be covered. A very inviting field of work seems to be opening out in connection with the alternator method of generation. With a suitably designed Goldschmidt high-frequency alternation it is said that a small variation in the exciting current will produce very large variations in the amplitude of the radiated waves. Hence the microphone can be placed in the excitation circuit, and need only have a current-passing capacity of a few amperes to be able to modulate a radiation representing a very large horse-power. To transmit articulate speech across the Atlantic will necessitate the power of varying the amplitude of continuous wave radiation representing at least 50 or 100 horse-power. This must be done by means of some microphone which passes not more than, say, 10 amperes. These conditions are not impossible of attainment. Hence Transatlantic wireless telephony may be said to be within the range of practical politics, whilst no improvements yet made in submarine telephonic cables hold out hope of being able within any reasonable time to speak through an Atlantic cable.

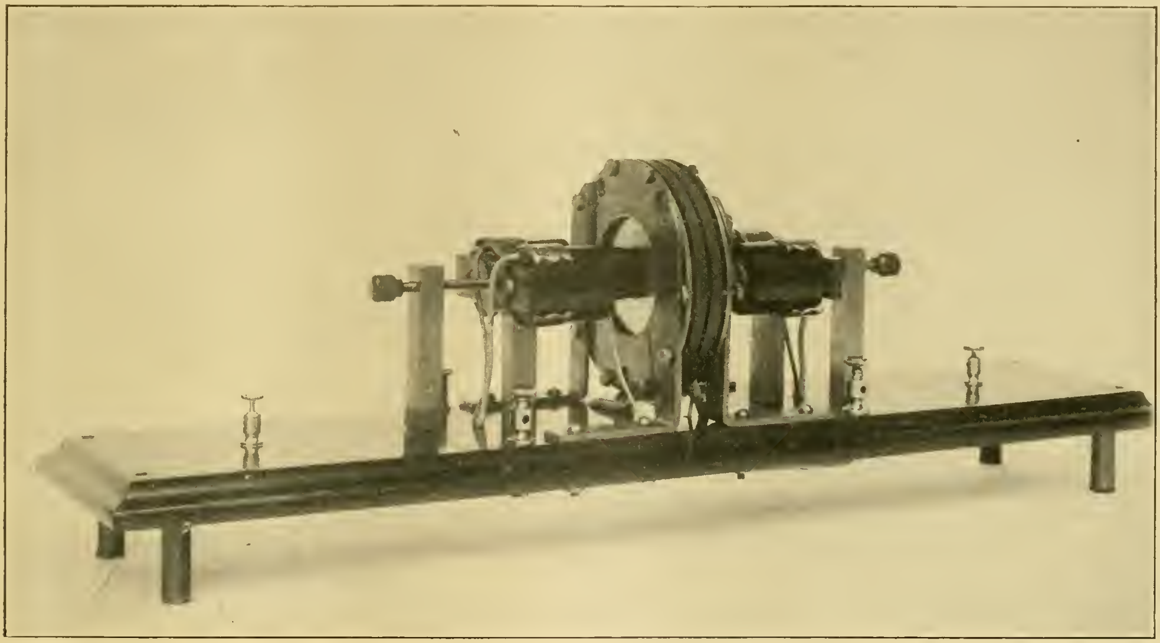


FIG. 3.—Dubilier water-cooled large current microphone.

The subject of wireless telephony is, therefore, one which holds out much promise for future achievement, and it is not surprising that it is attracting the attention of some of the leading workers in radiotelegraphy. J. A. FLEMING.

A BIRD WITH A HISTORY.[1]

A WELL-KNOWN ornithologist here gives us the fruits of many years of careful study devoted to a single species. His study has been diverse: at times it has lain among etymological dictionaries and curious old works on natural history, at times among the publications of

[1] "The Gannet: A Bird with a History." By J. H. Gurney. Pp. li+567+plates. (London: Witherby and Co., 1913.) Price 27s. 6d. net.

modern scientific societies and technical anatomical descriptions, and again in the open air on those rocky islets where the birds congregate in their thousands during the months of the long nesting season.

It is not every bird that deserves to be made the subject of a handsome and expensive monograph, but the gannet, as our author shows, makes more than ordinary claims on the interest and attention of the naturalist. And it is only just that a British naturalist should be the historian in this case, for of the fifteen breeding localities of the gannet, no fewer than nine lie off the coasts of our islands. Moreover, of the estimated total gannet population of 101,000

Gannets on the Bass Rock. From "The Gannet: a Bird with a History."

birds (exclusive of nestlings), 75,000 are allotted to these nine haunts. The British colonies are Lundy Island (recently abandoned); Grasholm, off Pembrokeshire; the Little Skellig and the Bull Rock, off the south-west of Ireland; Ailsa Craig, in the Firth of Clyde; St. Kilda (three colonies); Sulisgeir, to the north of the Lewis; the Stack of Sule Skerry, to the west of Orkney; and the Bass Rock. In the Færöes there is a colony on Myggenæs, while off Iceland there are colonies in the Vestmann Islands and the Eldey group, and a very small one on Grimsey, which is on the north coast, and lies within the Arctic Circle. Across the Atlantic there are colonies on Bonaventure and the Bird Rocks, in the estuary of the St. Lawrence; while there, as here, former sites, long since abandoned, are also known.

Mr. Gurney points out that these colonies, without exception, are on rocky islands, and that no mainland site, past or present, is anywhere known. Furthermore, the great majority of those on this side of the Atlantic lie off westerly coasts; the Bass Rock is, indeed, the only British exception. Apart from these points, there is an interest even in the purely statistical side of the careful census, which Mr. Gurney has been able to make. There are few species the numbers of which can be estimated even approximately, and the figures given in this volume should form an interesting basis for comparison in the future.

The book opens with a discussion of the various vernacular and scientific names which the species has received: both "gannet" and "solan" are dealt with at length. Then come many interesting pages quoting historical references to the gannet, illustrated by quaint figures taken from the works of the early naturalists. The species is justly called "A Bird with a History."

Mr. Gurney devotes a chapter to each of the important colonies, and shows personal familiarity with them in many cases, and an exhaustive knowledge of their literature in all. History is then left for a discussion of the general habits of the gannet, its nidification and incubation, the growth of its nestling, its food and its manner of fishing, its powers of diving and its seasonal movements, and many another question. Nor is its relation to man neglected—its effect on fisheries and its use as food. Finally, the plumage, osteology, and general anatomy are discussed, and appendices are added dealing with its allies, its parasites, its fossil remains, and the like.

We may note the omission from the bibliography of Mr. Kirkman's recent important contribution ("The British Bird Book") to the study of the gannet's habits, but Mr. Gurney has missed little that throws light on the interesting bird which he has made the object of enthusiastic and fruitful study. Many useful maps and beautiful photographs are scattered throughout the work.

A. L. T.

DR. G. J. BURCH, F.R.S.

FEW men of science have had such a varied career as Dr. George James Burch, whose death we announced with regret last week. Born in 1852, he went in 1873 to Cheshunt College to study for the Nonconformist ministry, and in due course became a minister first at Leeds, and later at Oxford. But at Oxford his duties became to some extent uncongenial to him, and this fact, coupled with a very bad breakdown in health, induced him to give up his pastorate, and take up the study of science for which he always had a natural inclination. He was hampered by pecuniary difficulties which would have deterred most men from such a course, and only by the most heroic struggles could he and his newly-married wife keep their heads above water. As a means of livelihood he worked for six hours every day on the subject catalogue at the Bodleian Library, and only after this work was over was he free to study Chemistry for his Oxford degree course. In spite of this double call on his time, he found opportunity to carry out research, and in 1886 he began his work on the capillary electrometer with the late Sir John (then Dr.) Burdon Sanderson, the Professor of Physiology. From 1887 onwards they did a good deal of electro-physiological work together, the mechanical details of the apparatus used being gradually improved by Burch until the final present day form was evolved.

Burch also worked out a method for analysing the electrometer curves, and in December, 1887, wished to publish an account of his discoveries. Burdon Sanderson, who was always cautious about committing himself, dissuaded him from doing so: hence a description of the method was not actually published until 1890, when Einthoven independently described his method, and so deprived Burch of some of the credit of the discovery. In 1892 Burch published a more elaborate paper on the time relations of the excursions of the capillary electrometer in the Philosophical Transactions of the Royal Society, and other papers were published later in the Proceedings of the society.

Meanwhile, Burch in 1891 took up lecturing under the Oxford University Extension Delegacy, and in 1892 he became lecturer, afterwards professor, of Physics at University College, Reading. He still lived in Oxford, and went backwards and forwards to his work daily. This was a great strain on his health, so that in 1909 he broke down and had to resign his position, though he continued to teach in Oxford.

In the last eighteen years of his life Burch devoted most of his spare time to research in colour vision. Among his observations regarding the physiology of vision were a number bearing on the vexed problem of colour sensations. He was a convinced adherent of the Young theory of colour sense. He subjected himself to a series of severe experiments in which the eye was fatigued to certain colours by prolonged intense stimulation by appropriate parts of the prismatic spectrum, and the alteration in the colour of other parts of the spectrum when observed by the fatigued eye was examined. He supplied an interesting memorandum on this subject to the Board of Trade Committee on Sight Tests three years ago. A small book presenting a practical course of instruction in visual physiology embodied the class-work he conducted in the subject at the Physiological Laboratory at Oxford. It is not only extremely lucid, as was everything he wrote, but is strikingly original in scope and treatment, and contains a number of exercises, as, for instance, one on the measurement of visual acuity, devised entirely by the author. His combination of first-hand knowledge of physical and physiological experimentation fitted him to a degree which is quite exceptional for success in this branch of scientific study.

Dr. Burch was elected a Fellow of the Royal Society in 1900. H. M. V.

PROF. G. M. MINCHIN, F.R.S.

The death of Prof. George M. Minchin, F.R.S., on March 16, at sixty-eight years of age, has deprived science of an earnest and versatile investigator, and a wide circle of friends of a companion who will be greatly missed. Always active in body and alert in mind, Prof. Minchin caught the fire of life with both hands, and conveyed its benefits to all around him.

Prof. Minchin was appointed to the chair of mathematics in the Royal Indian Engineering College, Coopers Hill, in 1875, when he was in his twenty-ninth year; and he remained at the College until it closed, when he removed to Oxford, where he died. He took a leading part in the movement for the improvement of geometrical teaching in schools; and his little book "Geometry for Beginners" published in 1898, was an early and very favourable specimen of the methods of the reforming party. He was also the author of works on "Statics," "Uniplanar Kinematics," and "Hydrostatics"; and his treatment of all these subjects was original and distinctive. Less well known in scientific circles, perhaps, except among his friends, is a little volume of verse and prose entitled "Naturæ Veritas" published in 1887. His skill in writing verse was of no mean quality; and a humorous example of it will be found in Nature of April 14, 1898, in a poem entitled "Balnibarbian Glumtrap Rhyme." He was a lover of good English; and this regard for the purity of the language made his many contributions to our columns clear in expression as well as authoritative in opinion.

Probably the work by which Prof. Minchin will best be remembered is that on photo-electricity and selenium cells. He began his experiments on these subjects in 1877, and was led by them to the discovery of many interesting phenomena. He observed that electric currents are produced by the action of light on silver plates coated with collodion or gelatin emulsions of bromide, chloride, iodide or other silver salts, or with eosin, fluorescein, or other aniline dyes, when the plates were immersed in a suitable liquid and one plate was illuminated while the other was screened. In 1891 he exhibited these cells to the Physical Society, and also cells made by spreading melted selenium on metal plates and immersing them in liquids together with an uncoated plate. He found that some cells, termed by him "impulsion cells," had their sensitiveness altered by slight impulses or taps, and also by electro-magnetic impulses, such as are given by electric sparks or a Hertz oscillator at a distance; so that the cells embodied the principle of the coherer used for the reception of Hertzian waves.

The form of photo-electric cell afterwards adopted by Prof. Minchin consisted of two selenium-coated aluminium wires dipping into certain solutions. His "Seleno-aluminium Bridges," described in a paper to the Royal Society in May, 1908, consisted of two plates of aluminium separated by a very thin flake of mica and having a thin layer of sensitive (or conducting) selenium spread across one edge of the mica and the two adjacent portions of the aluminium plates. This further development of his photo-electric work was carried out in the electrical laboratory at Oxford.

Prof. Minchin's application of selenium cells to the measurement of starlight was a notable extension of his experiments. In 1894, in conjunction with Mr. W. E. Wilson, he used his cells to obtain measurable electro-motive forces from the light of planets and stars; and he was thus able to determine the relative intensities of the light of Jupiter, Venus and Sirius. Shortly afterwards, an improvement in the construction of the cells enabled measurements to be made of the E.M.F.'s of the light of Vega, Arcturus, Regulus, Procyon and other stars. A comparison of the results obtained by photo-electric measures with those of photometric measures of stellar magnitude showed close conformity.

Prof. Minchin was an M.A. of Dublin and a member of Queen's College, Oxford. He was elected a fellow of the Royal Society in 1895, and his many friends within the society and without join with the widow and his two children in sympathetic sorrow that the finger of death has touched one who was so rich in the physical and intellectual attributes of life. R. A. G.

NOTES.

We announce with deep regret the death on March 30, in his sixty-second year, of Prof. J. H. Poynting, F.R.S., professor of physics in the University of Birmingham.

Prince Arthur of Connaught has been elected a fellow of the Royal Society, under the statute which provides for the election of Princes of the Blood Royal.

We record with regret the announcement of the death on March 30, in his sixty-fifth year, of the Hon. Rollo Russell, author of a number of works on meteorology and other scientific subjects.

The death is announced, at eighty-one years of age, of Mr. G. Sharman, for more than forty years palæontologist to H.M. Geological Survey at the Geological Museum, Jermyn Street, London.

A handsome brass tablet to the memory of Captain Scott and the southern party of the British Antarctic Expedition was unveiled at St. George's Chapel Royal, Naval Barracks, Chatham, on March 29, by Admiral Sir Richard Poore, Commander-in-Chief at the Nore, and dedicated by Archdeacon H. S. Wood, Chaplain of the Fleet.

Dr. C. H. Browning has been appointed first director of the new Institute of Pathology of the Middlesex Hospital, which has been erected as the gift of Sir J. Bland-Sutton at a cost of between 15,000*l.* and 20,000*l.* Dr. Browning is at present director of the clinical research laboratories in connection with the University of Glasgow.

A strong committee, with the Speaker as president, has been formed in Cumberland, according to the *Times* of March 27, with the object of affording protection to the local fauna. Wherever possible tracts of natural ground will be set apart as reserves, one such tract, Kingmoor, near Carlisle, having been already secured. A "watchers' fund," to provide keepers for such reserves, is being formed, and a close watch is to be kept on nesting ravens, peregrines, and buzzards throughout the county.

In the *Times* of March 27 attention is directed to the lateness of the arrival in this country of spring migratory birds. This lateness is specially notable in regard to a great spring flight of immigrants from Central Europe, which, as recorded by a Norfolk correspondent in the same journal a few days previously, reached Yarmouth on March 11. In normal seasons such flights are usually over by the beginning of the month. A partial explanation may be found in the great drop in temperature which occurred on the Continent between March 10 and March 11, when there was a fall of 13° in the minimum.

The President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant in aid of scientific investigations concerning the causes and processes of disease:—(1) An investigation by Dr. Eardley Holland into the causes of still-births; (2) a continuation of the Board's inquiry into the cellular contents of milk, by Prof. Sims Woodhead; (3) a continuation of the Board's inquiry into the causes of premature arterial degeneration, by Dr. F. W. Andrewes; (4) an investigation by Dr. M. H. Gordon and Dr. A. E. Gow into the etiology of epidemic diarrhœa in children. Announcement of further investigations will be made at a later date.

A wish has been expressed in many quarters that the distinguished services which Prof. Charles Lapworth, F.R.S., has rendered to geology should be commemorated in some permanent manner. The council of the Vesey Club, Sutton Coalfield, of which Prof. Lapworth has been a vice-president for more than twenty-five years, proposes to make a donation from the funds of the club towards such a memorial, and to enable members of the club who desire to be identified personally with the project to participate also, a small committee has been appointed to collect subscriptions. The amount subscribed by members will be handed over in one sum with a list of names only of subscribers. Donations may be sent to Mr. H. H. Sherwood, 109 Colmore Row, Birmingham.

In honour of the memory of the late Henri Poincaré, and in order that his name may be associated with a fund for the encouragement of research in science, the president of the Institute of France, on behalf of the institute, is inaugurating an international subscription with the approval of the family, friends, and admirers of the great French mathematician. It is proposed to arrange for a medal with Poincaré's portrait inscribed on it, and to secure a fund, the proceeds of which will be employed to encourage and assist young men of science engaged in those branches of knowledge with which Poincaré's name is chiefly associated. Donations may be sent to M. Ernest Lebon, secretary and treasurer, 4*bis* Rue des Ecoles, Paris, V.

The tragic death of the late Dr. H. O. Jones and his wife in the Alps in August, 1912, was recorded in these columns at the time (vol. lxxxix., p. 638). We note with interest that a tablet bearing the following inscription has been placed on the walls of Lewis's School, Pengam:—"In affectionate remembrance of Humphrey Owen Jones, M.A., D.Sc., F.R.S., Fellow of Clare College, Cambridge. A distinguished worker in the field of physical chemistry—a former pupil of the school—who while on his honeymoon in the Alps was killed with his wife by falling from the Aiguille Rouge de Peteret on the 15th August, 1912, at the age of 34 years. This tablet is by the staff, boys, and friends of Lewis's School sorrowfully inscribed." In memory of his wife (whose maiden name was Muriel Edwards), who was a distinguished student of the University College of North Wales, a fund of about 70*l.* has been raised by her fellow-students and handed over to the college to found a "Muriel Edwards's Prize" for distinction in chemistry or physics.

The annual general meeting of the Ray Society was held on March 26, the president, Prof. W. C. McIntosh, in the chair. The report of the council commenced with an appreciative notice of the late president, Lord Avebury, and an expression of regret at his death, and stated that three volumes, a "Bibliography of the Tunicata," by the secretary, and vols. i. and ii. of the "British Parasitic Copepoda," by T. and A. Scott, for 1912 and 1913, had been issued during the past year; that the volumes for the present year would be vol. iii. of the "British Freshwater Rhizopoda," by G. H. Wailes, and vol. v. of the "British Desmidiaceæ," by W. and G. S. West; and that the issue for 1915 would be vol. iii., part 1, of the "British Marine Annelids," by the president. The account of income and expenditure showed that the finances of the society were satisfactory. Prof. McIntosh was re-elected president, Dr. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

The following are the lecture arrangements at the Royal Institution, after Easter:—Dr. W. Wahl, two lectures on problems of physical chemistry; Prof. W. Bateson, two lectures on (1) double flowers, (2) the present state of evolutionary theory; Prof. D'Arcy W. Thompson, two lectures on natural history in the classics; Prof. A. Fowler, two lectures on celestial spectroscopy: experimental investigations in connection with the spectra of the sun, stars, and comets; Prof. Svante Arrhenius, three lectures on identity of laws in general and biological chemistry; Prof. Silvanus P. Thompson, two lectures on Faraday and the foundations of electrical engineering; Dr. T. E. Stanton, two lectures on similarity of motion in fluids; Prof. C. J. Patten, two lectures on bird migration; Prof. J. W. Gregory, two lectures on (1) fiords and their origin, (2) fiords and earth movements. The Friday evening meetings will be resumed on April 24, when the Astronomer Royal, Dr. F. W. Dyson, will deliver a discourse on the stars around the north pole. Succeeding discourses will probably be given by Prof. Karl Pearson, Prof. F. Keeble, Mr. R. Mond, Prof. J. C. Bose, and Prof. W. H. Bragg.

In the *Times* of March 25 is announced the discovery at Kolophon, in Ionia, of a remarkable collection of Greek surgical instruments. They exhibit a type of workmanship unequalled in any other extant specimens, and generally reveal the high progress in surgery which the ancients achieved. With two exceptions all the instruments are of bronze, and even in the case of those made from steel a piece of bronze is added, preserved, apparently for ceremonial reasons as a mystic, sacred metal. The collection includes polypus pincers for the removal of growths, an elevator for raising a piece of depressed bone in the skull, a drill-bow for trephining the skull to produce an exit for the evil spirits which were believed to cause madness and epilepsy, a scoop or cuvette for gynæcological work, a cautery and probes of modern type, scales, and cupping vessels. It is to be regretted that this valuable collection has been secured for the Johns Hopkins University, and will shortly be taken to America. Models, however, are being made, and will be on view in London within a few weeks.

The royal medals and other honours of the Royal Geographical Society have been awarded this year as follows:—The Founder's medal to Prof. Albrecht Penck, professor of geography at Berlin University, and director of the Oceanographical Institute; the Patron's medal to Dr. Hamilton Rice, of Boston, U.S.A., who for ten years has been closely investigating a little-known part of the large region of northern South America drained by the headwaters of the Orinoco and of the northern branches of the Amazon; the Murchison grant to Commander H. L. L. Pennell, R.N., who was a member of the Antarctic expedition of 1910, and was specially selected by Captain Scott to command the *Terra Nova* after the landing of the shore party; the Gill memorial to Mr. A. E. R. Wollaston, who has made extensive journeys in many parts of the world for zoological and other work; the Cuthbert Peck grant to Dr. J. Ball, of the Geological Survey of Egypt, who has carried out a large amount of scientific geographical work; and the Back grant to Mr. J. N. Dracopouli, for his careful survey and other work in the Sonora desert of Mexico in 1911–12, and his expedition to the Lorian Swamp and neighbouring regions in 1912–13.

The annual report of the council of the Institution of Mining and Metallurgy was presented at the annual general meeting of the institution on March 26. The report refers to the purchase of the freehold of No. 1 Finsbury Circus, as a permanent home for the institution, and states that the stability of the institution and its future progress have been materially assisted by the gift of 5000*l.* by Lady Wernher, and the further gift of 5000*l.* by Lady Wernher and her co-executors. This sum of 10,000*l.* has been invested as the "Sir Julius Wernher Memorial Fund," and the interest accruing is available for the ordinary purposes of the institution. The council has established as a personal memorial, a "Sir Julius Wernher Memorial Lecture," to be delivered and published triennially. The first lecture will be delivered before the International Congress of Mining, Metallurgy, Engineering, and Economic Geology, to be held in London in July, 1915. The subject of the lecture will be "The Metalliferous Mining Industry in its Relation to the Development of the British Empire," and the name of the lecturer and other particulars will be duly announced. The total membership on December 31, 1913, was 2372, as compared with 2258 in the previous year. "The Consolidated Gold Fields of South Africa, Ltd.," gold medal has been awarded conjointly to Mr. A. J. Clark, and Dr. W. J. Sharwood, for their paper on the metallurgy of the Homestake ore, and its premium of forty guineas to Mr. L. H. Cooke.

A FEW days before his death Sir John Murray was gathering material in the library of the Royal Society of Edinburgh in preparation for his presidential address at the Meteorological Congress, which is to be held in Edinburgh during next September. The sudden and tragic end of a project just begun is infinitely lamentable, and one naturally asks what will become of Medusa Villa as a centre of scientific activity. The terms of Sir John Murray's will have been so far made public as to bring a great relief to all who knew and appreciated the work which was always being carried on under his direct supervision. The books and collections, especially those bearing on deep-sea deposits, oceanography, and limnology, are to be kept together, along with furniture, instruments, fittings, etc., in the Villa Medusa, so that scientific work may be carried on there for twenty years. A certain number of shares in the Christmas Island Phosphate Company (Limited) are to be devoted to this purpose, the dividends being applied in scientific research or explorations or investigations which are likely to lead to an increase of natural knowledge, particularly along the lines indicated above. The carrying out of this project is left in the hands of his children. Very liberal powers are given in regard to special schemes, such as a scientific exploration of Canadian lakes or oceanographic expeditions. Should a case of substantial expenditure arise, it is suggested that the Challenger Society or the Royal Society of London or the Royal Society of Edinburgh might be consulted. Provision is made for the disposal of the collections and the library and the Christmas Island shares after the lapse of twenty years; or the arrangement may be brought to an end at an earlier date if the dividends should seriously decrease. In the obituary notice last week reference was made to the bathymetrical survey of the fresh-water lochs of Scotland. It should have been said that while Sir John planned, directed, and assisted financially the survey of the lochs, a large part of the expense was defrayed by Mr. Laurence Pullar, as a memorial to his son.

FOLLOWING an article on "The Spider Sense," several letters upon this subject have appeared in the *Times* (March 18–26). Certain people, we are told, are able to detect the presence of a spider (or cat) by means of a "sixth sense." The use of the term "sixth sense" indicates the complete innocence of psychology that characterises the whole correspondence. As to the fact, Prof. Meldola (March 26) is fully justified in pointing out that the neglect of the "negative instance" makes the proffered evidence totally unconvincing. Probably many people believe they can tell when they are being stared at from behind, but a recent experimental test revealed no such ability. On the other hand, such sensitivity does not seem *a priori* impossible. Sensory acuity varies greatly in different individuals and in special conditions. Thus some blind persons can perceive objects at a distance. This seems to be an abnormal development of a normal form of cutaneous sensitivity, the sense-organ being the skin of the face and the drum of the ear. Again, remarkable degrees of hyperæsthesia occur in certain stages of hypnosis, and in the present instances there may possibly be something of the nature of hypnotic auto-suggestion. That smell may play some part, as suggested by Mr. Ponder (March 25) is possible. This sense is imperfectly understood; how, for instance, is a hound able to avoid "back-tracking"? Even in the human its potentialities seem very elastic. Helen Keller, having lost her sense of smell for a few days, says: "A loneliness crept over me as vast as the air whose myriad odours I missed." But the existence of the "sense" and its nature should be quite simply determinable by experiment. Mr. C. Sully, assistant lecturer in psychology at King's College, London, will be glad to hear of a suitably endowed person willing to act as subject.

THE *National Geographic Magazine* for February reprints an important report by Mr. F. K. Lane on the conservation of the national undeveloped resources of the United States, particularly in connection with Alaska. This State contains the largest area of unused and neglected land in the country. Its resources are enormous in minerals, forests, and land available for cultivation. Hitherto lack of organisation has impeded development; but if the scheme now formulated is adopted this great national estate will become highly valuable.

THE fourth part of vol. i. of the Sarawak Museum Journal is devoted to an elaborate paper by Mr. Sidney H. Ray on the languages of Borneo. This collection of tribal glossaries was begun by Mr. Ray when he visited Sarawak on his return from the Cambridge Anthropological Expedition to Torres Straits in 1898–9. Additions were made to these by Dr. A. B. Meyer, whose papers on his death in 1911 came into Mr. Ray's possession. He has now published these glossaries with notes on the geographical distribution of the tribal dialects. It may be hoped that these collections will form the basis of a comparative study of this little-known group of languages. The value of the collection, not only to philologists, but also to anthropologists, is much increased by the addition of an extensive bibliography of books and papers on the Borneo tribes and their dialects.

In the Report of the Indian Museum, Calcutta, for 1912–13, Dr. Annandale is enabled to record an increase in the number of visitors, and likewise to chronicle the occupation and installation of the new laboratories and offices on the top of the Chowringhi side of the main building. The whole of the old building has been made over to the Geological Survey.

In vol. x., part 7, of the Annals of the South African Museum, Mr. K. H. Barnard continues his account of the crustacean fauna of South Africa, dealing in the first instance with the marine Isopoda, of which two genera and numerous species are described as new. Of much more general interest is his description of a new species of the genus Phreatoicus from Table Mountain; the genus being the typical representative of a southern terrestrial and fresh-water family of the Isopoda, containing three other genera. Hitherto the Phreatoicidæ have been known only from Australia, Tasmania, and New Zealand, and it is therefore of great interest to find it represented in South Africa, and that, too, by a member of the typical genus. Whether the group will ultimately turn up in South America remains to be seen, but the new discovery affords additional evidence of the community of the fauna of the old "Gondwanaland."

We have been favoured with a copy of a summary, by Dr. Max Fürbringer, of the scientific results of Prof. R. Semon's zoological expedition to the Malay Archipelago and Australasia, as worked out by specialists in the six volumes of the well-known "Zoologische Forschungsreisen," to which this "Schlussübersicht" forms an appendix. Prof. Semon started on his journey from Jena in June, 1891, remaining from the following September until January, 1892, in Australia, and spending from February until May in visiting Easter and other islands, and the south coast of British New Guinea. At the end of October, 1892, he arrived in Java, whence he proceeded to the Mollucas, Celebes, etc., finally returning homeward in April, 1893. On his arrival scientific work was commenced with the least possible delay, so that the "Reisen" embodies the results of some twenty years' labour. How greatly these labours have augmented our knowledge of marsupials, monotremes, Ceratodus, and many other groups, to say nothing of their bearing on the problems of distribution in the Austro-Malay area, is well known to every working zoologist.

An instructive account of experiments on the manuring of grass land in Oxfordshire has been prepared by Mr. G. R. Bland (Bulletin 15, University College, Reading). The work, which was commenced in 1909, has been carried out with special reference to the conditions obtaining with soils of different geological formations, and, in order to allow of comparison in other cases, a geological and a rainfall map of the county are included. The scheme of manuring is, if anything, rather limited in scope, but the general character of the account with regard to yields, profit and loss, botanical composition of the herbage and photographs of certain of the plots, is of great value, and is worthy of imitation by other county workers.

In a contribution to the *Journal of Agricultural Research*, Mr. G. N. Collins describes a drought-resisting adaptation in maize which appears to possess considerable economic value for conditions in semi-arid regions. Experience has shown that, in the case of common varieties, if the seed is planted at the customary depth, many seeds fail to germinate from insufficient moisture; if planted deep enough to come in contact with moist soil, the plants may fail to reach the surface. A study of the varieties grown by the Hopis and other agricultural Indians shows, however, that these varieties possess two special adaptions: (1) a greatly elongated mesocotyl that permits of deep planting, and (2) the development of a single large radicle that rapidly descends to the moist subsoil and supplies water during the critical seedling stage. The productive power of some of these varieties compares favourably with that of ordinary "improved" varieties even when grown under irrigation conditions. On these grounds a further study of some of these special varieties seems desirable.

To restrain a horizontal pendulum from executing its own oscillations during the passage of earthquake-waves, some method of damping is usually resorted to, either the electromagnetic method of Galitzin, the air-damping of Wiechert, or the liquid damping of other seismologists. After three years' work in experimenting with free and damped pendulums, Dr. A. Cavasino concludes (*Boll. Soc. Sism. Ital.*, vol. xvii., pp. 89–101) that a damped pendulum still tends to oscillate with its proper period; that except with violent earthquakes the beginning of the movement is retarded, it may be for several minutes, as compared with that indicated by a free pendulum; and that less than one-half of the earthquakes recorded by a free pendulum are registered by a corresponding damped pendulum.

In the Proceedings of the American Philosophical Society, Philadelphia (vol. lii., No. 208, pp. 31–162), Mr. J. J. Stevenson brings to a conclusion his lengthy monograph on the formation of coal beds. Parts i. and ii. appeared in vol. l., and part iii. in vol. li., of the same journal. Whether geologists accept his views or not—and many geologists will do so—all will be grateful to him for his great labour in gathering together the opinions of others on this much-discussed subject, and for the pains he has taken in collecting evidence from modern deposits of carbonaceous material and from Coal Measures of all ages in all parts of the globe. The author concludes:—"The coal beds and the associated rocks are of land origin; the detrital deposits are those made by flooding waters on wide-spreading plains; the coal beds, in all essential features, bear remarkable resemblance to peat deposits, sometimes to the treeless moor, more frequently to the Wald moor." But, as he very truly says, many matters still await explanation, and he emphasises the fact that no extensive coalfield has yet been closely studied, for in spite of the imposing array of skeleton sections there is an astounding lack of detail respecting many matters which appear to have no important bearing on commerce. Until the topography and geography of the Coal Measures land have been worked out, geologists must be content merely with probabilities concerning the remarkable bifurcation of some coal beds, the variations in subordinate intervals between two approximately parallel coal beds, the presence of huge blocks of transported rock in coal and the associated rocks, the immensely long periods of stable conditions indicated by the thickness of some coals, and with similar problems.

An article, entitled "The Meteorological Service on Mercantile Vessels," appears in vol. ix. (1913–14) of the Italian *Annali Idrografici*. The author, Prof. L. Marini, chief of the meteorological branch of the Hydrographical Institute, points out that although meteorological observations have not been neglected by vessels belonging to the several important shipping companies, they have not hitherto been dealt with on the same scale as observations on land. The publication of pilot-charts of the Mediterranean has been left to other countries, *e.g.* the United States, Germany, and this country. It is now intended that Italy shall take her proper place in such work, and with this view an earnest appeal was made in a circular to the national navigation societies on June 1, 1912, by the Minister of Marine, in which he points out the provisions made for the successful working of the service. A long list of registers received by the institute during the succeeding half-year clearly shows that the appeal has met with a very favourable reception among the seafaring community; we may therefore confidently look forward to some valuable contributions in due course to the meteorology of the Italian seas and adjacent regions.

In the *Popular Science Monthly* for March Dr. P. G. Heineman advances the view that development of automobile traffic will be beneficial to public health in two ways: first, by the provision of dust-proof roads, thus minimising the diffusion of disease germs which are commonly associated with dust, and secondly by doing away with stables which are fertile breeding grounds for flies that act as carriers of disease.

Readers of the *Cornhill Magazine* for March will derive considerable enlightenment from the article entitled "After the Death of Euclid," in which Mr. C. H. P. Mayo endeavours to compare the advantages and disadvantages of the old and new methods of teaching geometry. While admitting that the new method is beneficial in many respects, the author evidently considers that the sacrifice of logical training involved in the change may seriously impair its educational value.

The March number of the Transactions of the Institution of Engineers and Shipbuilders of Scotland contains an important paper by Mr. H. Ollendorff on the utilisation of ground adjoining harbours and railway stations. He shows that by the use of suspension railways enabling the goods unloaded from ships at the wharf to be taken direct into the factory, the cost of transport is so far reduced that the "hinterland" of a harbour can be profitably utilised to about ten times the extent it is at present. On this ground he advocates the provision of suspension railways by public authorities, which at the present time provide cranes for service at harbours.

A paper by Hiromu Takagi on the thermomagnetic properties of magnetite, which appears in the third part of vol. ii. of the Science Reports of Tohoku University, Japan, casts some doubt on the accuracy of the results obtained by Prof. Weiss and Foex for the variation of the magnetic susceptibility of magnetite with temperature. They found that at about 680° C. the susceptibility showed a sudden decrease which they attributed to some change in the internal state of the artificial magnetite used by them. Such changes led Prof. Weiss to postulate the existence of the magneton or atom of magnetism which a substance can possess only in integral multiples. The present experiments on natural magnetite show that the substance neither follows Curie's law—susceptibility inversely as the absolute temperature—nor are there any sudden changes in the curve of susceptibility as a function of the temperature.

In the current number of the *Comptes rendus* MM. Charles Moureu and A. Lepape discuss the cause of the constancy of composition of crude nitrogen (nitrogen with the rare gases) from various sources. The ratios between the nitrogen, argon, krypton, and xenon have been found to be the same in gases derived from fire-damp, thermal springs, petroleum, volcanic gases, or the atmosphere. This constancy of composition of nitrogen from natural sources is regarded by the authors as having existed from the nebular stage of the solar system. The same number also contains some measurements by Georges Claude on the amounts of hydrogen, helium, neon, and nitrogen absorbed by charcoal at low temperatures, $-182\cdot5°$ for nitrogen, $-195\cdot5°$ for the other gases. The amounts of helium and neon absorbed are much smaller than the absorptions of hydrogen and nitrogen. The position of hydrogen is anomalous, since it deviates from the rule that the lower the boiling point the smaller the charcoal absorption.

Railless electric traction systems, otherwise designated the "trolley-bus" or "trackless-trolley," already form in several cities extensions to the tramways systems, and there are numerous applications to Parliament for the authorisation of similar lines. Mr. T. G. Gribble, in a paper on these systems read at the Institution of Civil Engineers on March 24, says that it requires no more current to carry the passenger by railless electric traction than it does by a tramway. The author shows that with a traffic density represented by a $2\frac{1}{2}$ minute service, the economy of construction in favour of railless electric traction is about 44 per cent., and in cost of operation about 7 per cent. The economy increases inversely with the traffic density; with a 30-minute service the economy of construction is about 70 per cent., and that of operation is about 36 per cent.

The annual volume of *Knowledge* for 1913 is now available. The twelve monthly issues of our contemporary together form a handsome book which makes a special appeal to readers interested in nature knowledge. Attention may be directed to the excellent illustrations, the plates particularly being well produced. The price of the volume is 15*s.* net.

SOON after the death of Prof. Henri Poincaré, four appreciative notices of his work in various departments of knowledge were contributed to the *Revue du Mois* by Profs. Vito Volterra, Jacques Hadamard, Paul Langevin, and Pierre Boutroux. These studies have now been published together in a volume entitled "Henri Poincaré: L'œuvre scientifique, l'œuvre philosophique" (Paris: Félix Alcan; price 3.50 francs).

THE annual report of the Board of Scientific Advice for India for the year 1912–13 has been received from Calcutta. The report is divided into sections dealing respectively with applied chemistry, astronomy, and meteorology, geology, geodesy, botany, forestry, zoology, veterinary science, and medical research work. An appendix by Dr. W. R. Dunstan contains the report on the scientific and technical investigations conducted for India at the Imperial Institute during the year ended June 30, 1913.

DR. W. LEIGHTON JORDAN writes, with reference to a paragraph on the origin of planetary surface features and the "heart-shaped" figure of the earth, which appeared in our issue of March 19 (p. 69), that in 1866 he applied the term "cardioid" to the earth's shape, and pointed out that the motion of the earth through space tends to create high land in the Antarctic and deep water in the Arctic region. A description of Dr. Jordan's views upon this subject will be found in his work entitled "The Sling" (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.).

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR APRIL:—

April 3. 15h. 6m. Mars in conjunction with the Moon (Mars 2° 0′ S.).
4. 4h. 28m. Neptune in conjunction with the Moon (Neptune 4° 30′ S.).
5. 23h. 0m. Neptune stationary.
6. 19h. 0m. Mercury at greatest elongation W. of the Sun (27° 46′ W.).
10. 15h. 0m. Mars at quadrature to the Sun.
15. 19h. 0m. Neptune at quadrature to the Sun.
17. 22h. 50m. Uranus in conjunction with Moon (Uranus 2° 20′ N.).
18. 12h. 13m. Jupiter in conjunction with the Moon (Jupiter 1° 50′ N.).
20. 22h. 24m. Mars in conjunction with Neptune (Mars 2° 34′ N.).
23. 2h. 33m. Mercury in conjunction with the Moon (Mercury 5° 30′ S.).
26. 18h. 20m. Venus in conjunction with the Moon (Venus 4° 52′ S.).
28. 11h. 11m. Saturn in conjunction with the Moon (Saturn 6° 22′ S.).

A NEW COMET.—A telegram from Prof. Kobold at Kiel reports the discovery of a new comet by Dr. Kritzinger at Bothkamp. The comet is of magnitude 9·5, and was picked up on March 29 at 15h. 29·1m. Bothkamp mean time. Its position is given as R.A. 16h. 11m. 40s., and declination 9° 31′ S., and the daily motion as +3m. 8s. in R.A., and −32′ in declination. It is described as having a tail.

JUPITER VISIBLE BEFORE SUNRISE.—The planet Jupiter can now be well seen in the mornings, and it is important that telescopic observers examine his disc carefully and note the chief features. Last year the equatorial current had increased its rate of movement, its rotation being 9h. 50m. 11s. from a number of spots on the south edge of the northern equatorial belt. Are these markings still visible, and what is their velocity as compared with that determined during the previous opposition?

The great red spot also exhibited a quickening of speed in 1914, the rotation period being 9h. 55m. 35s. It is probable that at the present time the red spot precedes the zero meridian of System II. (see ephemeris for physical observations of Jupiter in Nautical Almanac) about 3h. 40m. It is impossible to tell exactly, however, because the planet has been too near the sun during the past winter for corrective observations to be made. Transits of the red spot and hollow in the southern belt may, however, be looked for at the following times:—

		h.	m.			h.	m.
April 14	...	14	27	May 3	...	15	6
16	...	16	5	8	...	14	14
21	...	15	12	15	...	14	59
26	...	14	20				
28	...	15	58				

Some estimated transits would be valuable in order to determine what the rate of rotation has been during the last six months.

The great south temperate spot now precedes the red spot. The former was no less than about 135° in length during last opposition, and it may ultimately extend all round Jupiter and darken the previously brilliant south tropical zone.

A PROPOSED TOWER TELESCOPE.—From Modena we have received a pamphlet describing a tower telescope to be erected to the memory of Secchi. It is proposed to build at Reggio-Emilia in reinforced concrete a pyramidal structure 35 m. high. Its memorial character is to be expressed by making the work, decorated in what is described as the Chaldeo-Babylonian style, serve as a canopy to a seated effigy of Secchi, whilst at the four corners of the base will be placed gigantic statues of Copernicus, Galileo, Kepler, and Newton. The scientific purpose is to make the tower carry the heliostat and objective of a vertical telescope of the type so successfully employed at Mount Wilson. A sum of 500,000 lire (20,000*l.*) is required, of which about 150,000 lire had already been collected by a permanent committee.

This is not the only project now on foot to perpetuate the memory of an astronomer. An influential international comité d'honneur is inviting subscriptions for the erection of a monument to the memory of Laplace, at his birthplace, Beaumont en Auge (Calvados), Normandy.

ANNUAL REPORT OF THE HAMBURG OBSERVATORY IN BERGEDORF.—The report for 1912 of the Hamburg Observatory in Bergedorf has just come to hand. It shows that great strides have been taken since this site was occupied, in spite of various hindrances regarding the larger instruments. Thus the large reflecting telescope had to undergo a change in the method of mounting the mirror, that used by Common and Ritchey being finally adopted. The report gives a brief *résumé* of the work of the various branches accomplished during the year, and an appendix contains a table giving the corrections to the Norddeich and Eiffel Tower wireless time signals. The report is accompanied by some good reproductions of some of the larger telescopes, and two pictures of the annular solar eclipse of April, 1912, secured by Prof. A. Schwassmann with the Lippert astrographic instrument.

OPTICAL ROTATORY POWER.

THE Faraday Society has adopted in recent years the policy of organising a series of general discussions on physico-chemical subjects, to which investigators of all countries are invited to contribute. The ninth of these discussions, on optical rotatory power, was held in the rooms of the Chemical Society on Friday, March 27. At the afternoon session the chair was occupied by Prof. Armstrong, who contributed an introductory address; the evening session was presided over by Prof. Frankland. Papers were read by Prof. H. Rupe, of Basle, on the influence of certain groups on rotatory power, by Prof. H. Grossman, of Berlin, on the rotatory dispersion of tartaric and malic acids, by Dr. T. M. Lowry and Mr. T. W. Dickson, on simple and complex rotatory dispersion, by Dr. T. M. Lowry and Mr. H. H. Abram on an enclosed cadmium arc for use with the polarimeter, by Dr. R. H. Pickard and Mr. Joseph Kenyon, on the rotatory powers of the members of homologous series, and by Dr. T. S. Patterson, on the dependence of rotation on temperature, dilution, nature of solvent, and wave-length of light. Papers were also communicated by Prof. L. Tschugaeff, of St. Petersburg, on anomalous rotatory dispersion, by Dr. E. Darmois, of Paris, on the existence of racemic tartaric acid in solution, by Dr. G. Bruhat, of Paris, on the rotatory power of tartaric acid, and by Prof. A. Cotton, of Paris, on the constitution of liquid mixtures and their rotatory power.

Two distinct schools of research were conspicuous in the papers and in the discussion. The attempts to find a relationship between chemical constitution and the rotatory power of compounds for sodium light received its greatest impetus from the theory put forward in 1892 by Crum Brown and Guye, to whom, at the suggestion of Prof. Armstrong, greetings were sent from the meeting; this school of research was well represented by Prof. Frankland, who had no difficulty in showing that results of very great value had been obtained from observations made with light of one colour only, that of the sodium-flame. Prof. Rupe gave a masterly summary of his work on the influence of unsaturated groups on rotatory power; this work had also been done mainly with sodium light, but there was no reason to suppose that the results would have been essentially different if light of other colours had been used. Dr. Patterson, in describing his observations on the influence of temperature and of solvents on the rotatory power of the tartrates for sodium light, was able to show that there is an essential unity in the effects produced by these two widely different factors; this unity could be extended to include some features in the behaviour of these liquids towards light of different colours, as recorded by Winther and others.

An element of novelty attached to the description of several series of researches which depended on the measurements of rotatory dispersion—a subject which has come suddenly to the front, both in England and on the Continent, during the course of the last two or three years. The apparatus required for measuring rotatory dispersion was exhibited by Mr. Abram, who also succeeded in showing an enclosed cadmium arc in actual operation. This arc is likely to be of great value in experiments on rotatory dispersion, because it provides a pair of lines, Cd 5086 (green) and Cd 6438 (red), which can be read with the same accuracy as the mercury lines, Hg 4359 (violet) and Hg 5461 (green). Thus it has been used to prove that α-methylglucoside, a compound which contains five asymmetric carbon atoms, obeys strictly the simple dispersion law given by the formula,

$$a=\frac{k_0}{\lambda^2-\lambda_0^2}.$$

This law also holds good for a long series of alcohols prepared and described by Dr. Pickard and Mr. Kenyon, the dispersive power of which remains constant over wide ranges of temperature, and may persist almost unchanged throughout the whole range of a homologous series.

Rotatory dispersion has usually been classified as *normal* when the rotation increases steadily as the wave-length diminishes, and as *anomalous* when in any part of the spectrum the rotation diminishes with the wave-length. The most familiar examples of anomalous rotatory dispersion are (i) tartaric acid, for which a remarkable series of data were recorded in M. Bruhat's paper; (ii) ethyl tartrate, studied exhaustively by Dr. Patterson; and (iii) methyl malate, which has been examined by Grossman in nearly one hundred different solvents. More recently Dr. Pickard and Mr. Kenyon have detected the same phenomenon in the simple esters of their optically active alcohols, and also in the α-naphthylmethylcarbinol,

$$C_{10}H_7.CH(OH).CH_3,$$

when this is examined in the superfused state.

Dr. Patterson protested against a classification which represented ethyl tartrate as showing "normal" dispersion in some solvents and "anomalous" dispersion in others. He argued that it was merely a matter of accident whether the maximum of optical rotation occurred within or without the region of the spectrum used for the polarimetric observations. This contention was supported by Dr. Lowry and Mr. Dickson, who were able to quote cases in which the camera had revealed a maximum beyond the limits of visual observation. They proposed to describe as *simple rotatory dispersion* all those cases to which the formula,

$$a=\frac{k_0}{\lambda^2-\lambda_0^2}$$

can be applied. All cases in which two or more terms are required to express the dispersion, thus—

$$a=\frac{k_1}{\lambda^2-\lambda_1^2}\pm\frac{k_2}{\lambda^2-\lambda_2^2},$$

were to be described as *complex rotatory dispersion*, whether the curves were anomalous or apparently normal in the region investigated. Simple rotatory dispersion may be detected very easily by plotting $1/a$ against λ^2, when the experimental data are found to fall on a straight line. When two terms, with constant values of λ_1^2, and λ_2^2, are sufficient to express the rotatory dispersion of a substance over a wide range of experimental conditions, the "characteristic diagram" of Armstrong and Walker will plot out to a series of straight lines, but this will no longer be the case if three "dispersion-constants," λ_1^2, λ_2^2, λ_3^2, are required.

The cause of anomalous rotatory dispersion was discussed by Prof. Tschugaeff. It can be produced by mixing two substances of opposite rotatory power and unequal dispersion (Biot) or by superposing two partial rotations, as in the camphorsulphonate of menthol (Tschugaeff). It may also be produced by an absorption-band in the visible spectrum (Cotton's phenomenon), or, as R. W. Wood has pointed out, by a band in the infra-red region. The view that anomalous rotatory dispersion is usually caused by the presence of two species of optically active molecules in the liquid was adopted by Armstrong, Grossman, Pickard, and other speakers; in support of the same view, it was stated in the discussion that nitrocamphor, which exists in two isodynamic forms, gives anomalous rotatory dispersion in acetone, and that ethyl tartrate may be fractionated into portions which differ very widely in their rotatory power for violet light, although the differences are small when green or yellow light is used.

LIZARD VENOM.[1]

THE results of a comprehensive study of the poison of Heloderma, undertaken by several observers, under the direction of Prof. Leo Loeb, at the laboratory for experimental pathology, University of Pennsylvania, are published by the Carnegie Institution of Washington in the volume before us.

Heloderma, or the Gila monster, is a lizard attaining the length of 2 or 3 ft., which inhabits the dry regions of Mexico and Arizona. It is of alarming appearance, and regarded by the natives with the utmost dread, although the results of a bite from this reptile are not very serious to man. The two species of the genus are peculiar in that they are the only reptiles other than snakes which possess poison glands in relation to some of their teeth. Unlike the poison glands of snakes, those of Heloderma are situated in the lower jaw, and consist of four independent sacs on each side, which open into separate cup-like depressions of the mucous membrane just external to the anterior mandibular teeth. When the jaw is closed the corresponding teeth project into these depressions and thus both upper and lower sets become bathed with the secretion.

The first article contains a good account of the anatomy and histology of the poison gland, and is followed by one on the histological changes in the gland after stimulation by pilocarpine. Then follow papers on the general properties and action of the venom and on some experiments in immunisation. The general lines followed in these studies are those previously traversed by various observers with snake-poisons, with which Heloderma venom has many similarities. The venom is an albuminous fluid, but the albumen can be coagulated by boiling without destroying the toxic principle. The latter is, however, carried down in the precipitate, to which it apparently adheres. This toxin seems, in fact, to adhere to almost any kind of fine precipitate, and this property has led to difficulty in all attempts to separate the essential poison.

The main poisonous constituent of the venom is a neurotoxin, and death is caused by gradual paralysis and ultimate cessation of respiration. From experiments upon isolated strips of cardiac muscle, the heart does not seem to be directly affected and the fall of blood pressure following the injection of the venom is presumably due to paralysis of the vasomotor centres. The nerve cells of animals killed by the venom show chromatolytic changes similar to those observed by Kilvington and Lamb and Hunter in snake poisoning. The venom has no influence on the coagulation of blood, nor does it produce hæmorrhages. It does not itself hæmolyse blood corpuscles, but, if mixed with lecithin it gives rise to a hæmolytic substance. This, as has been shown to be the case with cobra venom, is presumably due to the action of the lipase it contains upon the lecithin. The subcutaneous injection of subminimal lethal doses is followed by a considerable but temporary leucocytosis. Admixture of the venom with leucocytes and staphylococci does not hinder phagocytosis.

The memoir concludes with an account of attempts to separate an active principle from the venom, using the methods by which Faust obtained a non-nitrogenous active body in the case of cobra and crotalus venoms. These methods proved to be unsuitable, but by dissolving the venom in glacial acetic acid and precipitating, first with weak alcohol and then with stronger alcohols, and ultimately with ether, it was found that the successive precipitates with alcohol contained less protein and more active substance, and that the final precipitate with ether was protein free, but very active.

The above short *résumé* gives some idea of the extent of these researches, although a number of papers included in the volume, of less general interest, have not been referred to.

The work seems to have been carefully planned and performed, but the statements about snake venoms are occasionally inaccurate, as, for instance, the affirmation on p. 56 that the venoms of Hoplocephalus and Pseudechis may be heated without injury, and on p. 60, that the "venom of Viperidæ" does not pass through a Chamberland filter.

C. J. MARTIN.

[1] "The Venom of Heloderma." By Leo Loeb, with the collaboration of a number of workers. Pp. vi+244. (Washington: Carnegie Institution of Washington, 1913.)

CHINESE PALÆONTOLOGY.[1]

THE volume before us contains the palæontological results of the Carnegie expedition to China in 1903–4, and is an important contribution to our knowledge of the Palæozoic faunas of eastern Asia. The principal memoir is by Dr. Walcott, and deals with the Cambrian fossils which were found in large numbers. A total of sixty-three genera and 245 species are described and figured, and of these thirty-six genera and 175 species are trilobites (including five genera peculiar to China) and thirteen genera and thirty-six species are brachiopods. The oldest fossiliferous rocks are referred to the upper part of the Lower Cambrian and contain the Redlichia fauna, so that we are now acquainted with this fauna from Shantung, Yun-nan, Spiti, and western and southern Australia, as well as from the Salt Range where it was first found. It is, however, from the Middle Cambrian that the richest and most varied fauna was obtained in the Chinese provinces of Shantung, Shen-si, Shan-si, and in Manchuria, as was the case in the central Himalayas. A rapid process of evolution under new conditions of environment was originated at this period, accompanied by the more or less complete isolation of parts of the marine area, leading to the formation of local faunas. But on the whole the affinities of the Asiatic Cambrian fauna prove to be with the Cordilleran Province of western North America, and with the Upper Mississippian Province of the United States rather than with Europe. This is emphasised by the absence of the genus Paradoxides in western North America, China, and India, though other genera connect these areas with the Atlantic Province. In the Upper Cambrian a similar relationship is noticeable. From the evidence now available Dr. Walcott recognises three faunal provinces in Asia

[1] "Research in China." Vol. iii., The Cambrian Faunas of China, by C. D. Walcott; A Report on Ordovician Fossils Collected in Eastern Asia in 1903–4, by S. Weller; A Report on Upper Palæozoic Fossils Collected in China in 1903–4, by H. Girty. Pp. vi+375+29 plates. (Washington: Carnegie Institution of Washington, 1913.)

in Cambrian times, and these he terms respectively the Shantung Province (including Manchuria and Shan-si), the Punjab Province (including Yun-nan), and the Siberian Province.

Passing to the description of the new genera and species from China, we cannot help regretting that there is a general absence of individual comparison of the new forms with previously established or well-known species from other lands. It would have been especially valuable to have had their affinities discussed by Dr. Walcott, with his ripe experience and world-wide knowledge of Cambrian fossils. He indeed expresses the opinion that the excellent illustrations of the new species will enable other investigators to pursue such a study as occasion requires; but no plates or figures, however good, can remedy such a defect in the original descriptions, and this omission robs the memoir of much of its value.

The Ordovician fossils described in the second section by Dr. Weller, have been obtained partly from Shantung and partly from Ssï-ch'uan. The former are very poor and few in number, and no specific determinations were found possible, but their stratigraphical horizon is believed to be Middle Ordovician. The fossils from eastern Ssï-ch'uan are quite different in character and in much better preservation. They were obtained from a thick limestone resting conformably on the Cambrian, and consist chiefly of brachiopods and trilobites, some species of which were described in 1901 by Martelli from Shen-si. Richthofen's Ordovician fossils from northern Ssï-ch'uan, collected more than thirty years ago, are regarded as indicating the same geological horizon which Dr. Weller correlates with the Mohawkian (Middle Ordovician) of North America. The fossiliferous Ordovician beds of the central Himalayas, to which he makes no reference, have been regarded as of the same age. There is no similarity to the Ordovician faunas of eastern Yun-nan and Tonkin or of the Northern Shan States, but some species appear comparable or closely allied to Spiti forms; and in south-western Yun-nan it is probable that the Ssï-ch'uan fauna is represented. A conclusion of special interest at which Dr. Weller arrives is that there is a mixture of North American and Baltic forms in China, as in the Himalayas, where, however, the American element seems to be stronger.

The Carboniferous fauna described by Dr. Girty from Shantung, Shan-si, and Ssï-ch'uan is very scanty and of peculiar facies, but seems remotely allied to Russian and Indian faunas, and is considered to be of Upper Carboniferous (Pennsylvanian) age, with the exception of a few very doubtful fossils. The rich Middle and Upper Carboniferous faunas described by Kayser, Loczy, Mansuy, and Deprat from other parts of China appear to be unrepresented.

F. R. C. Reed.

MARINE BIOLOGY.

The life-histories of the Pacific Coast salmon and the halibut caught off the west coast of North America form the subject of two papers just published by Dr. J. P. McMurrich in vol. vii. of the Transactions of the Royal Society of Canada. In this work the author puts the method of scale examination to a somewhat severe test. It is fairly certain that this line of investigation must be regarded only as supplementary to detailed research by means of fishery experiments and statistical studies; such is the experience of most workers in Europe. Yet Dr. McMurrich does not hesitate to describe the conclusions that may be deduced from the study of the scales of twenty-two, or ten, or even three fishes, as "remarkably definite." The species of Oncorhynchus (the Pacific salmon) spawn only once in their lifetimes. The Pacific halibut becomes mature in its eighth year, and then enters upon a period of reproductive maturity. The ova ripen gradually, and "spawning is not a matter of a few days or even weeks, but is prolonged over, it may be, several years." This is too exceptional and improbable a result to deduce from a microscopic examination of the scales of three fishes, especially when the author admits that practically nothing is known as to the life-history of the halibut in North American waters. It is also incorrect to say that planktonic ova of this fish have not been found in European waters. Less, perhaps, is known about the halibut than most other Pleuronectids, but our ignorance is not such an utter blank as is suggested in the paper noticed.

Part i. of the Journal of the Marine Biological Association, published in November, 1913, contains papers dealing with varied aspects of marine biology. Mr. J. H. Orton, in a most useful paper, describes the functioning of the ciliary mechanisms on the gills of Amphioxus, Ascidians, and Solenomya. English writers, apparently accepting as correct the earlier work of Fol, have described food collection as occurring in the endostyle of Ascidians, the solid particles being then conducted along the peripharyngeal grooves, and so into the dorsal groove. Mr. Orton points out that no food-matter at all is taken up by the endostyle. The latter secretes mucus, which is then driven dorsally over the pharynx to the dorsal groove. Essentially the same mode of functioning of the ciliary tracts occurs both in Amphioxus and Ascidians. The pharynx in these animals, and the gills in Lamellibranch molluscs, are not respiratory mechanisms, but organs which function as water-pumps and food-collectors. In the same number of the journal there is an account of some very interesting experiments made by Mr. J. Gray with the object of investigating the chemical and physical changes which occur when the egg of the sea-urchin is naturally fertilised. The entrance of the sperm into the egg raises the electrical conductivity of the latter, the change attaining a maximum within ten minutes of the addition of the sperms to the ripe eggs. The egg-membrane in the unfertilised condition is remarkably impermeable to electrolytes, its surface being polarised. Probably the entrance of the sperm effects depolarisation and increases the permeability of the membrane to ions, but in some fifteen minutes polarisation again occurs, and the egg returns to its electrical state prior to fertilisation. Five other papers in the journal are written by zoologists of University College, Aberystwyth, and deal with sea-anemones, with the habits of the Galatheidea, and with the littoral fauna of Cardigan Bay. Dr. Th. Mortensen writes also on the development of some British Echinoderms. This number of the journal is altogether a very interesting one.

J. J.

CRYSTALLINE STRUCTURES AS REVEALED BY X-RAYS.[1]

The analysis of crystal structure by means of X-rays depends on the fact that a pencil of X-rays of uniform quality is reflected by a crystal face when, and only when, it meets the face at exactly the proper angle. As we shall see presently, the effect depends on the regularity of the crystal structure according to which the atoms of the crystal are arranged in planes, which are parallel to the face and regularly spaced. There is a certain relation between

[1] From a lecture delivered before the Manchester Literary and Philosophical Society on March 18, by Prof. W. H. Bragg, F.R.S.

the wave-length of the X-radiation, the spacing of the planes, and the proper angle of incidence. If we always use the same rays, and measure the angles at which they are reflected by the different faces of a crystal, natural or prepared, we discover the relative spacings of the many systems of planes which can be drawn regularly through the atoms of the crystal; and hence the actual arrangement of the atoms can be deduced. It is in this way that the structure is analysed.

Let us first consider some details of the reflection effect. The theory is not entirely strange to us, for Lord Rayleigh carefully investigated a strictly analogous phenomenon twenty-five years ago; this was the brilliant coloration of crystals of chlorate of potash. When white light falls on these crystals there is a strong selective reflection of rays the wave-lengths of which are confined within very narrow limits. R. W. Wood has prepared crystals which reflect waves the limits of which are no wider apart than the two D lines of sodium. Rayleigh showed that the effect was due to the existence of regularly spaced twinning planes parallel to the reflecting surface. He pointed out the analogy to other physical problems in sound, and in a Friday evening discourse at the Royal Institution he illustrated the effect by reflecting a high-pitched note by a series of parallel muslin sheets stretched tight and evenly spaced.

Rayleigh showed that in these and parallel cases the reflection must be total provided the number of planes was sufficiently great, no matter how feeble the reflection from each plane. In the present case the wave-lengths of X-rays are many thousands of times smaller than the waves of light which Rayleigh used; and the crystal planes being at atomic distances from each other are also many thousands of time closer than the twinning planes of chlorate of potash.

It is found that pencils of homogeneous X-rays suitable for use in the experiment, are contained in the general mass of radiation issuing from an X-ray bulb. The antikathode of the bulb emits "lines" or rays of definite wave-length which are characteristic of the material of which it is made.

The platinum antikathode gives a spectrum containing five sharply defined and intense lines which stand out well from the general radiation. The osmium spectrum appears to have five similar triplets instead of the five lines of the platinum, the head of each triplet coinciding with a platinum line. Several substances ranging in atomic weight from silver down to calcium emit similar spectra consisting each of two strong lines, increasing regularly in wave-length as the atomic weight decreases. A large number of these have been photographed by Moseley. Bulbs having rhodium or palladium antikathodes have been exceedingly useful in the crystal analysis, as they last well, their line spectra are very intense, and the wave-lengths are of convenient magnitude. The principal rhodium line is really double; and it will serve to illustrate the surprising exactness of the reflection effect when it is stated that the two constituents are just separated by reflection at the cleavage face of the diamond. The glancing angles are then 8° 35′ and 8° 39′.

Let us next consider the application of these principles to the determination of crystal structure. We take first, naturally, the large class of cubic crystals which are not only of high importance, but also of the most simple construction.

The atoms of a crystal can be arranged in the form of a repeated group or pattern. Each group is to be supposed to contain as few atoms as possible consistent with the requirement that the whole crystal can be built by packing these groups together, all the groups being similar and similarly oriented. If a point is chosen similarly in each group it serves to indicate the position of that group relative to other groups. An arrangement of points chosen in this way shows the basal structure of the crystal, and is known as a "space lattice."

There are three space lattices which give cubic character to crystals. In the first the representative points are placed at the corners of a cube; the whole lattice consisting of a repetition of this arrangement in all directions in space. In the second there are representative points at the corners of a cube, and the centre of the cube; in the third at the corners of a cube and at the middle points of the faces. The three are called the cubic, the centred cubic, and the face-centred cubic respectively.

These three types of lattice can be at once distinguished from each other by the X-ray method. Suppose we consider three important types of plane which may be drawn through the atoms of a cubic crystal, that is to say, planes perpendicular to (*a*) a cube edge, (*b*) a face diagonal, (*c*) a cube diagonal. If we draw a diagram or build a model we find readily that the relative spacings of the three sets are different in the different crystals, and this causes corresponding differences in the angles of reflection of some standard line.

Proceeding on these lines we come at once to a case of great importance. Rock-salt or sodium chloride and sylvine or potassium chloride have long been known to be of similar construction, though the nature of the construction has been uncertain until now. X-ray analysis shows, however, that the former crystal has the characteristics of the third class of lattice, and the latter of the first. Moreover, it appears that the elementary group or pattern contains the same number of atoms in each case. There is one obvious way of explaining these facts. Suppose that we place chlorine atoms at the corners of a cube and at the centres of the faces and sodium atoms at the middle points of the edges of the cube and at the cube centre, and take this to represent the structure of rock-salt. Potassium chloride may be derived from sodium chloride by replacing the chlorine atoms of the structure by potassium. Now it appears from a number of mutually supporting indications that the contribution of an atom to the reflection effect depends on its atomic weight only. The atoms of potassium and chlorine are of very nearly the same weight, and can be looked on as equivalent. If this is done the structure of potassium chloride is in effect the simple cubic. But there is a great difference between the weight of sodium and chlorine, and the face-centred arrangement of the chlorine atoms taken separately gives its character to the whole rock-salt structure. All this agrees with experiment. But there is more. The presence of the sodium atoms amongst the chlorine, arranged as a matter of fact on a face-centred lattice of their own, modify the purely face-centred character of the spectra, and experiment shows that the modification is exactly such as theory predicts.

It is impossible in a short account to describe in full the work that has or can be done. Moreover, description is difficult without the aid of a plentiful supply of diagrams or models. It will be sufficient to say that the examination of the positions of the spectra, and especially of the relative intensities of the different orders give information which is gradually being interpreted. The simpler crystals have already been analysed, and the structure of many of the more important cubic crystals is known. The more complex structure of the calcite series has been determined, and something has been discovered of the still more difficult structures of sulphur and of quartz. It must be remembered that in all these cases complete analysis requires not merely the determination of the lattice, but, what is far more difficult, the arrangement of the atoms in the group which is represented by each point on the lattice.

We may consider certain points of more general interest. The structure of the diamond stands out with some prominence. It is interesting to find that the carbon atoms are arranged in the most beautifully symmetrical pattern, each being at the centre of a regular tetrahedron composed of its four nearest neighbours. Rings of six carbon atoms are a predominating feature. Planes perpendicular to a cube diagonal—the diamond is, of course, a cubic crystal—are arranged in a curious way, the spacings being alternately large and small in the proportion of three to one. This leads to the extinction of the second order reflection from these planes. The effect can be readily illustrated optically by ruling a diffraction grating in the corresponding fashion. Zincblende has exactly the same structure as the diamond, but the alternate planes of the kind just mentioned contain alternately zinc atoms alone and sulphur atoms alone. This explains the well-known polarity of the crystal. Iron pyrites has a rather more complicated structure, which explains at once the curious disposition of the striations on its faces. Sulphur has eight interpenetrating lattices, quartz three of silicon and six of oxygen. In each of these two cases there is regular spacing of the lattices along the long axis, but not in other directions.

The atoms of a crystal are not, of course, at rest; the extent of their movements depends on thermal considerations. As the temperature rises the motion increases. According to theory, this must tend to destroy the intensity of the spectra, particularly those of higher order. Experiment confirms the theoretical deduction, and gives some promise of being able to decide between conflicting hypotheses as to the extent of the thermal influence. It is curious to observe the angles of reflection diminish as the crystal expands with heat and the spacings of the planes increase. The method might even be applied to the measurement of coefficients of expansion of crystals.

Lastly, the study of the X-ray spectra emitted by various substances when made the antikathodes of the X-ray bulb gives valuable information respecting atomic structure, and is most skilfully made use of in the investigations which are being conducted in the physical laboratory of the University of Manchester.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—Prof. H. H. Jeffcott has been appointed by the Senate to the chair of engineering tenable at University College, vacated by the appointment of Prof. J. D. Cormack to a professorship at Glasgow. Prof. Jeffcott was educated at Trinity College, Dublin, and is now professor of engineering in the Royal College of Science, Dublin.

The D.Sc. degree in physics has been granted to Dr. E. E. Fournier d'Albe, Royal College of Science and Birmingham University, for a thesis on the efficiency of selenium as a detector of light.

Evidence is to be presented, on behalf of the University, to the Departmental Committee of the Board of Education in regard to external students, without being restricted to the recommendations of the Royal Commission.

Mr. C. A. King has been appointed professor of mechanical engineering in the Civil Engineering College, Sibpur, India.

A free scholarship of the value of 30*l*., tenable at the Northampton Polytechnic Institute (London) is being offered to students. In view of the openings which the calling and craft of optics now offer, this "Aitchison Memorial Scholarship," should prove most attractive to intelligent youths. The subjects of examination include English, mathematics, and elementary physics. Full particlars can be had of the hon. treasurer, Mr. H. F. Purser, 39 Charles Street, Hatton Garden, London, E.C.

A copy has been received from New York City of a volume entitled "A Study of Education in Vermont prepared by the Carnegie Foundation for the Advancement of Teaching at the request of the Vermont Educational Commission." The legislature of Vermont on November 19, 1912, appointed a commission to report on the educational responsibilities of the State. On February 24, 1913, the commission invited the Carnegie Foundation to undertake an expert study of the school system of the State, including the higher institutions of learning. The resulting report provides much information and enumerates the conclusions and recommendations of the foundation. Among other recommendations the withdrawal of State subsidies from all higher institutions not owned and controlled by the State is suggested. Three colleges are now subsidised by the State of Vermont, and these have some 1026 students, 565 of which are provided by Vermont itself, while 400 Vermont students attend colleges in other States. There are in every thousand of population in Vermont three students of higher education. In connection with the University of Vermont, one of the institutions aided by the State, strong courses in the humanities and in the sciences are recommended, as well as the development by the University of the State Agricultural College.

The general and departmental reports for the session 1912–13 of the Bradford Technical College reveal a satisfactory growth in the usefulness of the institution. There was an increase in the attendance over the previous academic year. The arrangement under which advanced students in dyeing from the Leeds University attend a course in the practical dyehouse at Bradford was in work during the session. A number of Bradford students also attended special courses of lectures at the Leeds University. This reciprocal arrangement, having proved satisfactory, is being continued. The head of the department of textile industries reports that although no large increase in the number of day students is to be expected, it is worthy of note that attendance in the department forms a ready entrance into the higher walks of the textile industries in the case of students of ability who lack special influence in the trade. He points out also that the raising of the standard of attainment in the industry is possibly the most important work of the college evening classes, and those who have followed this development recognise the help which the college has rendered to the textile trade of the city in this direction. The work of the materials testing laboratory of the department of engineering is growing at a rapid rate, and at the present time more than one thousand tests per annum are being made for the various Government and corporation departments, and for local firms. This has the effect of bringing the work of the department into close touch with the engineering trade of the district, and a number of interesting problems of a practical character are forthcoming, in the solution of the majority of which the students are permitted to take part.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 26.—Sir William Crookes, president, in the chair.—J. H. **Mummery**: The nature of the tubes in marsupial enamel and its bearing upon enamel development. In the present paper the author has endeavoured to show that the tubes are dentinal tubes and not an enamel product, and that the penetration of the dentinal fibril results from the late and imperfect calcification of the cement substance between the prisms.—W. T. **Lockett**: Oxidation of thiosulphate by certain bacteria in pure culture. In the course of investigations on the oxidation of thiosulphate on bacterial sewage filters, it was found that the oxidation was due largely to the presence of living organisms. Experiments were undertaken with a view to the isolation of the organism or organisms capable of bringing about this oxidation.—A. E. **Everest**: The production of anthocyanins and anthocyanidins. The question of the production of Anthocyan pigments from the yellow pigments of the flavone and flavonol class is discussed. Evidence is brought forward to show that the Anthocyan pigments must be regarded as reduction products of flavone or flavonol derivatives, and that they are readily produced as glucosides from the glucosides of the yellow compounds without intermediate hydrolysis.—A. J. **Walton**: Variations in the growth of adult mammalian tissue in autogenous and homogeneous plasma. This paper considers the results of experiments performed to obtain information as to the presence in plasma of substances inhibitory to the growth of tissue. Several tissues were used and several plasmata were investigated.—E. C. **Grey**: (1) The decomposition of formates by *B. coli communis*; (2) the enzymes which are concerned in the decomposition of glucose and mannitol by *B. coli communis*.—Surg.-General Sir D. **Bruce**, Major A. E. **Hamerton**, Captain D. P. **Watson**, and Lady **Bruce**: (1) description of a strain of *Trypanosoma brucei* from Zululand. Part i.—Morphology. Part ii.—Susceptibility of animals. Part iii.—Development in *Glossina morsitans*. (2) The Trypanosoma causing disease in man in Nyasaland. Part iii.—Development in *Glossina morsitans*.

Linnean Society, March 19.—Prof. E. B. Poulton, president, in the chair.—Dr. E. F. **Armstrong**: The bearing of chemical facts on genetical constitution. The subjects dealt with were:—(1) The relation of enzymes to colour inheritance in plants; (2) the nature of oxydases; (3) the anthocyan pigments of plants and their mode of formation; (4) other plant pigments; (5) An hypothesis as to the relation between the several members of an epistatic series of pigments.

DUBLIN.

Royal Dublin Society, February 24.—Dr. J. H. Pollok in the chair.—Prof. G. H. **Carpenter** and T. R. **Hewitt**: The reproductive organs and first-stage larva of the warble-fly (Hypoderma). Descriptions with figures of the reproductive organs of both sexes of *Hypoderma bovis* are given, and comparative studies of the ovipositor and external male genitalia in *H. bovis* and *H. lineatum* have been made, very definite specific characters being apparent. The male genitalia of Hypoderma are symmetrical, and apparently more primitive than the corresponding structures in the blow-fly or house-fly, three pairs of gonapophyses being well developed. There are evidently ten segments in the abdomen of the male *H. lineatum*. The newly hatched larva of the warble-fly is exceedingly spiny, and provided with strong mouth-hooks and a sharp median piercer connected with the pharyngeal sclerites. In this stage the larva offers a marked contrast to the almost smooth second instar which is found in the wall of the ox's gullet.—J. E. **Collin**: Notes on the specimens of Borboridæ and some Ephydridæ in the Haliday collection in the National Museum, Dublin. The paper gives details of Haliday's type specimens, accompanied with systematic and synonymic notes. Many of the specimens are still in excellent condition after a lapse of eighty years.

EDINBURGH.

Royal Society, February 16.—Prof. J. Geikie, president, in the chair.—Dr. **M'Whan**: The axial inclination of curves of thermoelectric force: a case from the thermoelectrics of strained wire. The author found that when the thermoelectric force, for a given temperature difference, between strained and unstrained nickel was compared with the load, the relation was represented by a parabola the axis of symmetry of which was inclined to the coordinate axes, thus obtaining for the relation between electromotive force and longitudinal stress a relation similar to that which Mr. Hamilton Dixon had established for electromotive force and temperature.—A. R. **Fulton**: Rupture strains in beams and crane hooks. A modified theory as to the strains in bending as the elastic limits were approached was tested and verified by experiments on the rupture of beams and hooks.—Dr. H. A. **Haig**: A description of the systematic anatomy of a Fœtal Sea leopard (*Stenorhynchus leptonyx*), with remarks upon the microscopic anatomy of some of the organs: Scottish National Antarctic Expedition. The fœtus investigated had attained about one-third of its intra-uterine development, and was 122 mm. in length. The flippers were well formed, as also the nostrils and eyelids. Points of special interest were described in connection with the cerebellum, the heart, the position of the cæcal diverticulum, and the pituitary gland. The placentation of the seals resembled that of the cat or dog, the placenta being of the zonary type. A general survey of the developmental aspects indicated that certain organs of brain, internal ear, and pituitary were, comparatively speaking, more advanced than the same organs of the three-months human fœtus. Further investigation, more especially of the earlier stages, would be of great interest in connection with the pituitary gland and the kidney, the latter organ being of the type in which separate renal pyramids are met.

March 2.—Sir E. A. Schäfer, vice-president, in the chair.—Sir Thomas **Oliver** and T. M. **Clague**: Electrolytic method of treatment for blood poisoning.—Sir William **Turner**: The aborigines of Tasmania. Part iii. The hair of the head compared with that of other Ulotrichi, and with Australians and Polynesians. The paper consisted of a detailed examination of ulotrichous hair—that is, woolly or frizzly hair—as it is found in various African races, in the aborigines of Tasmania, New Guinea, and the Melanesian Islands, and in the Negritos of the Malay Peninsula, etc. The comparison was based upon the author's observations and measurements of the specimens which formed the collection in the anatomical museum of the University of Edinburgh, a collection which had been made over a number of years for the purposes of anthropological study.

MANCHESTER.

Literary and Philosophical Society, March 10.—Mr. Francis Nicholson, president, in the chair.—Prof. Edmund **Knecht** and Miss Eva **Hibbert**: *l*-Pimaric acid from French rosin. The authors described a method of obtaining lævo-pimaric acid from French rosin in a chemically pure state and in considerable bulk. Further, the composition, molecular weight, and the more important physical constants of the acid have been determined. The acid appears to be a derivative of the terpene or the camphene series. If treated for some time to the temperature of the boiling point of aniline (183° C.) the acid is converted into an anhydride resembling ordinary rosin in appearance. On dissolving this in alcohol or glacial acetic acid hydrolysis ensues, and an optically inactive (racemic) acid is obtained, possessing the remarkable property of showing in benzene or alcohol solution molecular weight of its optical isomer. The racemic compound can be resolved into its optically active components by means of *d*-tetrahydroquinaldine.—R. F. **Gwyther**: The specification of stress. Part iv., The elastic solution, the elastic stress relations, question of stability, struts, ties, and test-pieces. The author proposed a general dynamical solution of the elastic problem, but admitted that there are special cases. Certain hypotheses are made in the solution which from the dynamical point of view seem reasonable. Treating the statical case, the solution is found without the necessity of employing these hypotheses. If the statical result is a special case of the general dynamical result no question arises. But on introducing time-factors into the statical solution, the question arises whether the dynamical equations are generally satisfied, whether they are satisfied in some special way or whether they cannot in any circumstances be satisfied by the variation of the statical solution. The relations of stresses when all direct reference to strains is eliminated is considered, and it is shown how each element of stress can be represented in terms of the invariant of the three longitudinal stresses.

March 24.—Mr. Francis Nicholson, president, in the chair.—Faunal survey of Rostherne Mere, Cheshire. (1) Dr. W. M. **Tattersall** and T. A. **Coward**: Introduction and methods. The authors gave an account of the formation of the mere and its physical characteristics, pointing out that the mere was a dissolution basin formed as the result of subsidence of the earth's surface, consequent on the action of underground water in dissolving and carrying away rock-salt from the underlying strata. Accounts of the temperature of the lake and of the chemical composition of the water were given.—(2) R. S. **Adamson**: Preliminary account of the flora. A description of the marginal vegetation of the lake.—(3) T. A. **Coward**: Vertebrata. A list was given of the vertebrates which occurred in and round the mere. The author included only those vertebrates which were in one way or another influenced by the presence of the water, and were therefore factors in the ecology. Five mammals, seventy-six birds, and eleven fish were enumerated.—(4) A. W. **Boyd**: Preliminary list of lepidoptera. One hundred and forty-four species, found by the author during the last three years, were recorded. Three species were new to the Cheshire list. The tendency towards melanism, as is usual in the north of England, was noted in a number of species.

Paris.

Academy of Sciences, March 23.—M. P. Appell in the chair.—A. **Haller** and Ed. **Bauer**: Syntheses by means of sodium amide. The preparation of allyl ketones derived from the alkylacetophenones and pinacoline. It has been shown in a previous paper that the interaction of sodium amide, iodide or bromide of allyl, and acetophenone does not give allylacetophenones but only condensation products. With mono- and di-alkylacetophenones, however, the reaction goes normally, and allyl derivatives are formed. Details of numerous examples of this reaction are given.—Paul **Sabatier** and A. **Mailhe**: The use of manganous oxide for the catalysis of acids. The preparation of fatty and aryl ketones. The oxides of calcium or of iron, although giving satisfactory results in many cases, do not give satisfactory yields of ketones from *iso*butyric and *iso*valeric acids. A study of various oxides from this point of view has shown that manganous oxide, MnO, acts well as a catalyst, is not expensive, preserves its catalytic properties nearly indefinitely, and can be utilised for the production of aldehydes as well as ketones. The vapours of the acids are carried over a 60 cm. column of the MnO maintained at a temperature of 400° to 450° C. Numerous examples of the excellent yields obtained are given.—A. **Lacroix**: The laterites of Guinea.—Charles **Moureu** and Adolphe **Lepape**: Crude nitrogen (nitrogen and rare gases) in natural gas mixtures (see p. 120).—R. de **Forcrand**: Potassium tetroxide. The pure K_2O_4 has been prepared by two methods, and its thermochemical constants determined. The results are compared with those previously obtained for rubidium and cæsium.—A. **Calmette** and A. **Mézie**: The treatment of epilepsy by snake poison. The snake poison used was extracted from *Crotalus adamanteus*, injected in gradually increasing doses. The number of fits per annum was reduced in all the cases detailed, and this improvement was maintained after the treatment was stopped.—Lucien **Godeaux**: Involutions having only a finite number of points belonging to an algebraical surface.—M. **Gunther**: The general theory of systems of partial differential equations.—E. **Baticle**: The partial differential equations of the limiting equilibrium of a sandy mass, comprised between two surfaces of rectilinear profile.—Louis **Benoist** and Hippolyte **Copaux**: Application of the laws of transparency of matter to the X-rays to the determination of some contested atomic weights. The case of beryllium. The transparency of beryllium to X-rays corresponds to the atomic weight 9·1.—Georges **Claude**: The absorption of gases by carbon at low temperatures (see page 120).—A. **Leduc**: The density and atomic weight of neon. Eighteen litres of neon containing some helium and nitrogen as impurities were purified by treatment with charcoal cooled with liquid air. The density found was 0·696, or nearly 3 per cent. higher than the value found by Ramsay and Travers (0·674). From this is deduced that the atomic weight of neon is exactly twenty times that of hydrogen, or 20·15 for O = 16.—Jean **Bielecki** and Victor **Henri**: Contribution to the study of tautomerism. The quantitative study of the absorption of ultra-violet light by the derivatives of acetoacetic acid.—L. **Moreau** and E. **Vinet**: A method of determining traces of arsenic of the order of a thousandth of a milligram. The method is based on the production of a silver mirror in a small glass U-tube containing silver nitrate.—Mil. Z. **Iovitchitch**: The absorption of carbon dioxide from the air by chromium hydroxide.—A. **Joannis**: The constitution of potassium carbonyl. By the controlled action of water vapour upon the compound KCO obtained by the interaction of potassium and carbon monoxide, glycollic acid was obtained, according to the reaction,

$$K.CO-CO.K+H_2O=CH_2.OK-CO.OK.$$

—Félix **Bidet**: The hydrates of the primary amines. Normal and *iso*amylamines and *iso*butylamine combine with water vapour from the air and form well-crystallised hydrates, fusible below 100° C., and possessing high vapour pressures.—Const. A. **Ktenas**: The petrographical relations existing between the island of Seriphos and the neighbouring formations.—J. L. **Vidal**: The adaptation of the vine to the different conditions of life created by pruning at different periods and its consequences on the evolution of the reserve carbohydrates.—M. **Marage**: The action on certain organisms of an artificial current of water. An account of some experiments with the divining rod, in which the flow of water was controlled. For water flowing in pipes the experiments failed, as the person holding the divining twig was unable to detect the flow of water with certainty.—H. **Coutière**: The "ocular tubercles" of podothalmic Crustacea.—P. **Benoit**: The formation of the gonophore in *Tubularia indivisa*.—Bernard **Collin**: The involution forms of ciliated Infusoria in the renal organ of a Cephalopod.—Theodor

Mironescu: The action of some pharmaceutical substances on the development of experimental cancer.—A. **Blanchet**: The activity of the lipodiastase of castor oil seeds at a low temperature. Although the diastatic activity is reduced by lowering the temperature it is not entirely suppressed at -5° C.—L. **Cavel**: The transportation of micro-organisms into the atmosphere by the pulverisation of polluted water. The sprays in actual use in connection with bacterial beds for the treatment of sewage give up organisms to the surrounding air, and may be a source of danger in time of epidemics.—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis of the β-monoglucoside of glycol with the aid of emulsin.—Paul **Durandin**: The possible existence of oil-bearing strata in French Indo-China.—F. **Jadin** and A. **Astruc**: Manganese in some springs of the Vosges *massif*.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part 4 for 1913, contains the following memoirs communicated to the society:—

May 24.—G. **Angenheister**: The velocity of propagation of magnetic disturbances and pulsations (report on the instantaneous records of terrestrial magnetism in Apia (Samoa), Batavia, Cheltenham, and Tsingtao in September, 1911).

June 21.—H. **Bohr**: The significance of power-series of an indefinitely large number of variables in the Dirichlet series, $\Sigma a^n/n^s$.—O. **Faust**: The internal friction of fluids under high pressure.

July 7.—A. **Peter**: Injuries to forest-trees by lightning-stroke over large areas.

July 19.—C. **Carathéodory**: Boundary-adaptation in conformal representation.—L. **Föppl** and P. **Daniell**: The kinematics of Born's rigid body.

August 23.—B. **Meese**: Some observations on the optical constants of potassium and sodium.

November 1.—L. **Bieberbach**: A theorem of Carathéodory.—O. **Mügge**: Shearing-deformations in phosgenite and galena.—R. von **Mises**: The mechanics of solid bodies in the plastic-deformable condition.—G. **Tammann**: The discrimination of racemism from pseudo-racemism.

BOOKS RECEIVED.

Descriptive Geometry. Part i. Lines and Planes. By J. C. Tracy. Part ii. Solids. By H. B. North and J. C. Tracy. Pp. ix+126. New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

The Horticultural Record. Compiled by R. Cory. Pp. xv+500+plates. (London: J. and A. Churchill.) 42*s*. net.

Die Welt der Kolloide. By Dr. H. Leifer. Pp. 121. (Leipzig: P. Reclam, jun.) 80 pfennigs.

Papers and Proceedings of the Royal Society of Tasmania for the Year 1913. Pp. 337+xxii plates. (Hobart: Tasmanian Museum.) 15*s*.

Table Auxiliaire d'Intérêts Composés. By A. Trignant. Pp. viii+21. (Paris: Gauthier-Villars et Cie.) 2 francs.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 74 and 75. (Jena: G. Fischer.) 2.50 marks.

Die mathematischen Wissenschaften. Unter leitung von. F. Klein. Zweite Lief., Die Beziehungen der Mathematik zur Kultur der Gegenwart. By A. Voss. Die Verbreitung mathematischen Wissens und mathematischer Auffassung. By H. E. Timerding. Pp. 161. (Leipzig und Berlin: B. G. Teubner.) 6 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 41. (Jena: G. Fischer.) 5 marks.

Geological Survey of Alabama. Monograph 8. Economic Botany of Alabama. Part 1. Geographical Report. By R. M. Harper. Pp. 228+plates. (Alabama.)

Antarctic Penguins. By Dr. G. M. Levick. Pp. x+140+plates. (London: W. Heinemann.) 6*s*. net.

University of California Publications in Geography. Vol. i., No. 4. The Rainfall of California. By A. G. McAdie. Pp. 127–240+plates. (Berkeley, Cal.)

Eugenics Record Office. Bulletin 10*a* and 10*b*. The Scope of the Committee's Work. By H. H. Laughlin. Pp. 64. The Legal, Legislative, and Administrative Aspects of Sterilization. By H. H. Laughlin. (Cold Spring Harbour, Long Island, New York.) 20 cents and 60 cents respectively.

The South African Institute for Medical Research. Memoir No. 1. An Enquiry into the Etiology, Manifestations, and Prevention of Pneumonia amongst the Natives on the Rand, Recruited from Tropical Areas. By G. D. Maynard. Pp. 101+xi charts. (Johannesburg: South African Institute for Medical Research.) 5*s*.

Proceedings of the Rhodesia Scientific Association. Vol. xii. Containing Papers Read During 1912–13. Pp. 161. (Bulawayo.)

Nature and the Idealist. By H. D. Shawcross. Pp. xii+186. (London: Sampson Low and Co., Ltd.) 5*s*. net.

Some Minute Animal Parasites or Unseen Foes in the Animal World. By Dr. H. B. Fantham and Dr. A. Porter. Pp. xi+319. (London: Methuen and Co., Ltd.) 5*s*. net.

A Third Year Course of Organic Chemistry. The Heterocyclic Compounds, Carbohydrates, and Terpenes. By Dr. T. P. Hilditch. Pp. xii+411. (London: Methuen and Co., Ltd.) 6*s*.

Sumer is icumen in. By Dr. J. B. Hurry. Second edition. Pp. 53. (London: Novello and Co., Ltd.)

Structural Geology. By C. K. Leith. Pp. viii+169. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

A Flora of Norfolk, with Papers on Climate, Soils, Physiography, and Plant Distribution, by Members of the Norfolk and Norwich Naturalists' Society. Edited by W. A. Nicholson. Pp. vii+214+2 maps. (London: West, Newman and Co.) 6*s*.

Life and Human Nature. By Sir B. Fuller. Pp. xii+399. (London: J. Murray.) 9*s*. net.

Le Hasard. By Prof. E. Borel. Pp. iv+312. (Paris: F. Alcan.) 3.50 francs.

The Origin of the World. By R. McMillan. Pp. xiii+136. (London: Watts and Co.)

Guide to the Geology of the Whitby District. By L. Walmsley. Pp. 37. (Whitby: Horne and Son.) 1*s*. net.

Grundzüge einer chemisch-physikalischen Theorie des Lebens. By Dr. H. Lundegårdh. Pp. v+63. (Jena: G. Fischer.) 2 marks.

Ueber die Bedingungen der Gebirgsbildung. By Dr. K. Andrée. Pp. viii+101. (Berlin: Gebrüder Borntraeger.) 3.20 marks

Memoirs of the Geological Survey of India. Palæontologia Indica. New series. Vol. v. Memoir No. 1. Triassic Faunæ of Kashmir. By Dr. C. Diener. Pp. 133+xiii plates. (Calcutta: Geological Survey; London: K. Paul and Co., Ltd.) 4*s*. 4*d*.

The Synthetic Use of Metals in Organic Chemistry. By A. J. Hale. Pp. xi+169. (London: J. and A. Churchill.) 4*s*. 6*d*. net.

Modern Steel Analysis. By J. A. Pickard. Pp. viii+128. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

School Lighting. By E. H. T. Nash. Pp. 28. (London: J. and A. Churchill.) 1s. net.

Die Mechanik des Geisteslebens By Prof. M. Verworn. Pp. 92. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Tasmanian Bryophyta. Vol. i. Mosses. By L. Rodway. Pp. 163. (Hobart: Royal Society of Tasmania.) 5s.

Royal Society of Tasmania. The Foundation and Early Work of the Society, with Some Account of other Institutions of Early Hobart. By E. L. Piesse. Pp. 117–166. (Hobart: Royal Society of Tasmania.) 2s.

Allgemeine Ergebnisse und Probleme der Naturwissenschaft. Eine Einführung in die moderne Naturphilosophie. By Dr. B. Bavink. Pp. xiii+314. (Leipzig: S. Hirzel.) 6 marks.

Das neue Botanische Institut der Universität Innsbruck. By Prof. E. Heinricher. Pp. 18+iii plates. (Jena: G. Fischer.) 80 pfennigs.

Mysore Government Meteorological Department. Report on Rainfall Registration in Mysore for 1912. By N. V. Iyengar. Pp. xvii+49. (Bangalore: Government Press.)

Paul Ehrlich. Eine Darstellung seines wissenschaftlichen Wirkens. By H. Apolant, H. Aronson, H. Bechhold, J. Benario, and others. Pp. viii+668. (Jena: G. Fischer.) 16 marks.

DIARY OF SOCIETIES.

THURSDAY, APRIL 2.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Series Lines in Spark Spectra: Prof. A. Fowler.

ROYAL INSTITUTION, at 3.—The Progress of Modern Eugenics. II. Eugenics To-day: Its Counterfeits, Powers, and Problems: Dr. C. W. Saleeby.

CHILD STUDY SOCIETY, at 7.30.—The Nervous Child: Dr. L. Guthrie.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Signalling of a Rapid Transit Railway: H. G. Brown.

LINNEAN SOCIETY, at 8.—Plants, Natives of Australia found growing on the Banks of the Rivers Tweed and Gala; also Seeds from Australian Wool: Miss Ida M. Hayward.—Lantern Slides of Cape Plants, mostly in their Native Habitats. Second Series: W. C. Worsdell.—Mr. W. A. Lambourn's Breeding Experiments upon *Acræa encedon*, Linn., in the Lagos District of West Africa, 1910–1912: Prof. E. B. Poulton.—Structure of the Wood of Himalayen Junipers: W. Rushton.—A Contribution to the Flora of Fiji: W. B. Turrill.—A New Amphipodan Genus and Species (Family Dexaminidæ) from New Zealand: Prof. C. Chilton.

FRIDAY, APRIL 3.

ROYAL INSTITUTION, at 9.—Further Researches on Positive Rays: Sir J. J Thomson.

INSTITUTION OF CIVIL ENGINEERS at 8.—Fast Stirlingshire Waterworks, and a Note on Earthen Embankments: O. I. Bell.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of North Cornwall: H. Dewey.

SATURDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

MONDAY, APRIL 6.

SOCIETY OF ENGINEERS, at 7.30.—The Utilisation of Solar Energy: A. S. E. Ackermann.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—By-products from Peat: F. Mollwo Perkin.—Sulphuric Acid—the Swing of the Pendulum: H. E. Armstrong.—Table of Specific Gravities of Spirits for Use with Bedford's Tables: J. N. Rakshit and S. N. Sinha.—The Viscosity of Rubber Solution: R. Gaunt.

ARISTOTELIAN SOCIETY, at 8.—*Discussion*: The Value of Logic: Dr. A. Wolf and Dr. F. C. S. Schiller.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some Famous Maps in the British Museum: J. A. J. de Villiers.

VICTORIA INSTITUTE, at 4.30.—The First Chapter of Genesis: E. W. Maunder.

TUESDAY, APRIL 7.

RÖNTGEN SOCIETY, at 8.15.—The Energy of the Röntgen Rays: Dr. R. T. Beatty.

ILLUMINATING ENGINEERING SOCIETY, at 8.—The Lighting of Railway Carriages and other Public Vehicles: E. K. Scott.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea.—XIII. Two New Species belonging to the Genera Oochoristica and Linstowia, with Remarks upon those Genera: Dr. F. E. Beddard.—The Nature of the Lateral Muscle in Teleostei: E. W. Shann.—Report on the River-Crabs (Potamonidæ) collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: Dr. W. T. Calman.—Report on the Mammals collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: Oldfield Thomas.—Notes on a Collection of East African Mammals presented to the British Museum by G. P. Cosens: G. Dollman.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Transportation Problem in Canada, and Montreal Harbour: F. W. Cowie.

WEDNESDAY, APRIL 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

GEOLOGICAL SOCIETY, at 8.—The Evolution of the Essex River System, and its Relation to that of the Midlands: Prof. J. W. Gregory.—The Topaz-bearing Rocks of Gunong Bakau (Federated Malay States: J. B. Scrivenor.

THURSDAY, APRIL 9.

CONCRETE INSTITUTE, at 7.30.

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THURSDAY, APRIL 9, 1914.

A VOCABULARY OF EMBRYOLOGY.

Terminologie der Entwickelungsmechanik der Tiere und Pflanzen. Herausgegeben von Wilhelm Roux. Pp. xii+465. (Leipzig: W. Engelmann, 1912.) Price 10 marks.

THE science of embryology has its own evolution. Once upon a time it was no more than a science of observation; its task was to describe the form and structure of the embryo during growth, as the naturalist or the anatomist had described those of the organism when it was grown. Later on, in the light of the cell-theory, in the spirit of Darwinism, and with the help of Wolff's and Von Baer's laws, embryology became dominated by, even subjugated to, the historical method; its chief aim was "to form a basis for phylogeny," and its chief problems dealt with such matters as the retention of ancestral characters in embryonic and larval forms, the explanation on similar lines of functionless or atrophied organs, and the discovery of "homologies" between cells, germ-layers, and organs, even in distantly-related organisms.

Such, so far as it can be expressed in a sentence, was Balfour's attitude towards embryology, and so he defined its aims in the preface to his great text-book, adding, however, the important qualification "as restricted in the present work." One great problem, or class of problems, he expressly excluded, when he spoke of the embryological investigations of certain older writers as being "mixed up with irrelevant speculations on the origin of life." But inquiries into the character and inner nature of organic processes, and speculations on the nature and even the "origin" of life, recur continually to men's minds, and upon such inquiries embryological study has a bearing, which is by no means to be dismissed as irrelevant. So we come to a third, and nowadays important, phase of embryology, in which that science has become not merely a morphological, but a physiological, study, and is accordingly approached from the side of chemistry and of physics, with the aid of the known properties of matter and of energy.

The new and growing conception of embryology as a "dynamic" science, or series of dynamical problems, carries us a long way from the older and simpler embryology, with its "statical" outlook, its concrete description of forms and phases of form. It widens out and out into ways of experiment and analysis undreamed of a generation ago; it leads us, for instance (to name but a few names out of many), to the philosophical inquiries of Driesch, to the wide experimental field of Loeb and his followers, and to the general study of "developmental mechanics," which has been the life-work of Wilhelm Roux.

But "the house that is a-building is not as the house that is built." In the growth of a young science there is a stage when facts are heaped up in apparent confusion, out of which order and simplicity presently emerge. For a while, the workman is kept busy making his own tools, and in the growth of new knowledge and of new ideas language itself has to be strengthened by new words.

Common experience, and the Oxford Dictionary, show us how ill the older vocabulary sufficed to keep pace with last century's growth of ideas, even in the ordinary affairs of men. To natural science Huxley's generation contributed a new language, which we now speak familiarly; and once again, in the narrower field of embryology, we wake up to find that yet another language has become implanted in the old. We had better not ask whether all this new nomenclature be essential; some of it will doubtless pass away while part remains; meanwhile, it has grown by a natural process of evolution, and those must learn it who would master the teaching of the new schools. So Prof. Roux, with a little band of botanists and anatomists, has set himself in a true spirit of helpfulness to put in order the new terminology, and to teach this new language to those who have not learned it by the way.

His book is a book of reference, a means of interpretation, and a bibliographical guide; it is a dictionary, and those who find pleasure in the reading of dictionaries are few. Yet, after all, the book is something more than a book of reference or a mere vocabulary, for many of its paragraphs amount to short essays, where the student will find both information and instruction. This is not only the case in some of the larger articles, such as "Entwickelungsmechanik," "Kampf der Theile," etc., but in others also. Take at random, for instance, a little paragraph on "Scherenumkehr," or "Heterochelie"; here we have a concise introduction to a very singular phenomenon, witnessed among certain crabs, which ordinarily possess, on opposite sides, one large claw and one small one; if the former be chopped off, then the latter grows into a big claw, and the former big claw, after repair, comes to be a little one. The crab is perfectly regenerated, but its new form is a "mirror-image" of that with which it began. The article ends with references to papers wherein this phenomenon is discussed in its many curious modifications.

G

But while we may well be grateful to the writer who has tried in this little book to make a very difficult subject somewhat less difficult, it must be confessed that the book is too condensed, too strenuously logical, and, moreover, too much occupied by questions of priority, to attract the general scientific reader, or, indeed, any but the professed student of its own subject. Prof. Roux has greater powers than are put in action here. Haeckel's "Generelle Morphologie" is now practically obsolete; but it marks an epoch in biological science, and it stands as a monument of clear thinking and lucid scientific expression. Let us hope that some day or other Prof. Roux will give us not only a vocabulary, not only isolated researches, however important, but will crown his labours by the writing of a newer and a better "Generelle Morphogenie." D. W. T.

RUBBER AND RUBBER PLANTING.

Rubber and Rubber Planting. By Dr. R. H. Lock. Pp. xiii+245+x plates. (Cambridge: University Press, 1913.) Price 5s. net.

Dr. R. H. Lock was connected, until recently, with the Botanic Department at Peradeniya, Ceylon. In conjunction with other officers of that department, he conducted a series of very valuable experiments in connection with the tapping of rubber trees.

The book before us contains much that has already been published by the author officially in Ceylon. The diagrams and photographs illustrate many interesting features in connection with Hevea, Manihot, Castilloa, Funtumia, Ficus, and Landolphia, such as is rarely found in a book on rubber.

The book deals with the botanical sources and history of rubber, physiology of latex, the usual planting and harvesting operations, and the various pests and diseases of rubber plants. Each chapter is written in a very easy and popular style, and the subject-matter can be easily understood by the general reader.

The special line of work in the book is that which relates to tapping operations. When dealing with the effects of wounding the bark, the author lays stress upon the fact that any system of tapping which involves the cutting of the whole circumference of the tree at one time is bad. He suggests that in no circumstances should more than one-half of the total circumference of the tree be tapped at one time.

The yield of rubber bears a peculiar relation to the volume of bark on the tree. An instance is quoted of one tree which in three years yielded 240 lb. of dry rubber; the rubber was contained in 70 gallons of latex, equivalent to 20,000 cubic inches. This yield of 20,000 cubic inches of latex was obtained by tapping an area of bark which had contained only 500 cubic inches of latex at the beginning of the experiment. The problem, therefore, resolves itself into one of the origin of the balance of 19,500 cubic inches of latex. The author concludes that the greater part of the latex can only have been produced by secretion of latex in the existing laticiferous tissue, thus suggesting that the latter is an organ for the actual manufacture, as well as storage, of the milky liquid.

It is common knowledge among experimenters in the tropics that the yielding capacity of rubber trees exhibits enormous variation. It is this variation which renders the majority of the public records of experiments valueless. Dr. Lock shows in certain experiments that the highest and lowest average yields for particular operations were respectively 106 and 8 cubic centimetres. The yield per unit of bark removed was in the ratio of 317 to 25—a variation of 1,000 per cent. in yields from trees which to the author appeared to be somewhat similar. In addition to this variation in yield, there is an equally marked variability in composition of the latex according to frequency of tapping, season of tapping, altitude, and so forth.

In the middle-East, the majority of planters tap the same area on the same day, or on alternate days, the intervals between successive tapping operations being regarded as sufficient to enable the latex to accumulate to the desired quantity and degree of concentration. Dr. Lock is probably the first experimenter who has continued experiments for a period of four years, and herein lies the great value of his work. The majority of tapping experiments have usually lasted a number of months, and on that account alone are apt to be highly misleading.

Dr. Lock concludes that, after $3\frac{1}{2}$ years' continuous tapping, the yield from trees tapped once a week may become as great or greater than that from trees tapped at any shorter interval. It was this conclusion which gave rise to a controversy in the columns of the *India-rubber Journal*, which in turn led the Rubber Growers' Association in London to take up experimental tapping on various Eastern estates. Later publications from Malaya do not agree with the result obtained from Dr. Lock in Ceylon, but this might very well be due to the fact that the experiments in Malaya have not been continued for the same period of time.

Altogether, the book can be regarded as being of great value, not only to the practical man on the estate, but also to investigators in this country.

H. W.

WATER SUPPLIES.

(1) *Studies in Water Supply.* By Dr. A. C. Houston. Pp. xii+203. Macmillan's Science Monographs. (London: Macmillan and Co., Ltd., 1913.) Price 5*s.* net.

(2) *Water: its Purification and Use in the Industries.* By W. W. Christie. Pp. xi+219. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(1) DR. HOUSTON has gathered together an epitome of his own researches, which have been scattered among a considerable number of reports and papers. In the first chapter, which deals with sources of water-supply, he directs attention to the remarkably low death-rate from typhoid fever in London during the past few years, a rate which in the year 1911 amounted to only 0·03 per thousand of the population. After discussing the rivers Thames and Lea as sources of water-supply, he proceeds in subsequent chapters to give results of his observations upon the purification of water, finally concluding the volume by a discussion and description of the methods carried out under his direction in the laboratories of the Metropolitan Water Board.

The main conclusions which Dr. Houston draws from a large amount of experimental work may be summarised as follows:—River water exposed to manifold pollutions, and furnishing ample chemical and bacteriological evidence of objectionable contamination, may fail to show any or scarcely any of the microbes of water-borne disease; and he raises the question as to whether we have not exaggerated the value, high as it is, of the sand filter as a factor in our long-continued immunity from typhoid fever, and whether some at least of this freedom may not be due to the fact that the water was not primarily so noxious as it has hitherto been regarded. He is convinced that artificially-added typhoid bacilli die fairly rapidly in stored water, even when such water is of great initial impurity, and that a preliminary storage of water is an important factor of safety. This purification of water under storage conditions is chiefly due to the sedimentation, equalisation, and devitalisation of microbes; and he shows that by the second week the reduction in the artificially cultivated typhoid bacilli added to river water is more than 99 per cent. on the average, and that storage reduces the number of bacteria of all sorts and devitalises the survivors, if sufficiently prolonged.

Taking the chemical and bacteriolegical results together, Dr. Houston demonstrates that the beneficial effect observed in connection with simple continuous flow settlement of water may be considerably enhanced by the use of coagulants, such as aluminoferric, etc. He finds that when a hard water is overdosed with lime a considerable bactericidal effect is produced; and if after a suitable interval sufficient untreated water is added to combine with the excess of lime, a much safer water for drinking purposes is obtained. Speaking generally, these experiments demonstrate that the bactericidal dose of lime for hard waters would appear to be rather less than 1 to 5000, and with very soft waters 1 to 50,000. This method is especially attractive in cases where a water, bacteriologically impure, has in any event to be softened, and where a contaminated river supply has scarcely any available storage accommodation prior to sand filtration.

The author is to be congratulated, not only upon the good work to which the volume bears testimony, but also upon bringing it together in this monograph, and presenting it in a condensed and readable form.

(2) Mr. Christie's small work is mainly composed of a series of articles which appeared in "Industrial Engineering and Engineering Digest" for 1910-1911, and it is to be commended more particularly for its treatment of the use of water in various branches of industry. While much useful information is given upon the subject of the purification of water which would fit it for drinking purposes, this portion of the book is less satisfactorily dealt with than that which is concerned with the use of water for industrial purposes. Indeed, the treatment of the sources of water, its analysis and standards of purity, is fragmentary and unsatisfactory. It is impossible to deal with the subject of the standards of purity of water except in regard to the sources from which the water is derived. More particularly is this necessary with reference to chlorine standards; and the standard given for chlorine in water, of from 3 to 10 parts in a million, is useless and misleading. Extremely few of the drinking water supplies of this country would conform to such a standard. The chapters on water softening, pressure filters, oil filters, and boiler waters are the best contributions to a work which is exceedingly well produced, the illustrations being a noteworthy feature of the publication.

OUR BOOKSHELF.

From the Letter-Files of S. W. Johnson. Edited by his Daughter, Elizabeth A. Osborne. Pp. 292. (New Haven: Yale University Press; London: Oxford University Press, 1913.) Price 10*s.* 6*d.* net.

No teacher of agricultural chemistry can afford to do without Johnson's two books, "How Crops Grow," and "How Crops Feed." If he tries it, he will miss two most valuable sources of help for his lectures. The first was written in 1868, and instantly achieved a most remarkable popularity, being translated into French, German, Russian, Swedish, Italian, and Japanese, besides being revised and adapted for English readers by Church; the second appeared two years later, and was almost equally successful. Neither book is ever likely to get out of date, because each deals so fully with the fundamental experiments carried out by men who were laying the foundation of what has since become a great subject.

The book before us gives an account of the life of the writer of these books, and incidentally throws much interesting light on the opening chapters of the history of agricultural chemistry. Samuel William Johnson was born in 1831 at Kingsboro, in what was then the new country of Northern New York State. In 1849 he had saved enough to justify his entering Yale to study chemistry under Prof. J. P. Norton; from the outset he took a special interest in agricultural chemistry. Four years later (in 1853) he went to Leipzig to work under Erdmann, and then in 1854 to Munich to study under Liebig. He then came to England for a short time to study gas analysis at the Owens College, Manchester. On his return to New Haven he did a good deal of missionary work among farmers to demonstrate the enormous value of chemistry to the agriculturist, and became appointed chemist to the Connecticut State Agricultural Society in 1857. After eighteen years of work, the first agricultural experiment station in the States was founded; in the spring of 1875 the Legislature of Connecticut State passed a measure securing 700 dollars a quarter for two years for the maintenance of a laboratory placed at their disposal by the University at Middletown.

The history of these pioneer days is well told in Johnson's letters, and they make very interesting reading. The editor is to be congratulated on the way the material has been collected and arranged. E. J. Russell.

The Cancer Problem: a Statistical Study. By C. E. Green. Third edition. Pp. 98 + plates. (Edinburgh and London: William Green and Sons, 1914.) Price 5*s*. net.

This book belongs to the all too numerous class of harmful publications on the subject of cancer. The author frankly states he is not a qualified medical man, but this fact will have little weight with the lay public. The sub-title, "A Statistical Study," conveys an entirely erroneous impression as to the scope of the book. It is in reality a plea for the infective nature of cancer, and of the active intervention of coal-smoke as an augmenter of the frequency of the disease. The alleged parasite is likened to the well-known *Plasmodiophora brassicae*, which causes finger and toe disease or club-root in turnips and cabbages. This vegetable parasite is not "almost unknown to pathologists," but has had its alleged claims to resemble a supposed cancer parasite discussed *ad nauseam* by pathologists and botanists of the highest repute. The author argues that coal-smoke manures the soil for this "cancer parasite."

The error of likening cancer to finger and toe disease has been often exposed. As for statistics, none are contributed by the author. His figures state the number of deaths from cancer as a percentage of deaths from *all* causes, and he marvels that 1 in 7 is from cancer in the Strand district, but only 1 in 54 in Stepney. This statement is illuminated by photographs of the roofs of these two districts. No mention is made of Charing Cross Hospital being situated in the Strand district.

The statements as to the cure of cancer are deserving of severe condemnation. Only the harm the book may do has justified any notice being taken of it. It is with regret that the reviewer feels obliged to judge thus harshly what the perusal of the book proves has been a labour of love, carried out with the best intentions; but the pursuit of a hobby ought not to be encouraged to the public danger. E. J. B.

The Socialized Conscience. By Prof. J. H. Coffin. Pp. viii + 247. (Baltimore: Warwick and York, 1913.) Price 1.25 dollars.

Prof. Coffin's purpose in this interesting book is to suggest, using modern psychological and sociological terms, a moral criterion by means of which the different types of moral situations may be met with consistency by ordinary human beings. He applies the criterion to a great variety of questions, including personal relationships, educational agencies, the State and the Church. His chapters are stimulating and thought-impelling.

Descriptions of Land: a Text-book for Survey Students. By R. W. Cautley. Pp. ix + 89. (New York: The Macmillan Company, 1913.) Price 4*s*. 6*d*. net.

All students of surveying in Canada before securing official recognition are required to pass an examination on "descriptions of land," which is one branch of conveyancing. Many lawyers in all countries are ignorant of the elementary principles of surveying, and few surveyors are able to understand the intricacies of a complicated title. Mr. Cautley has written on the subject in a way which should be useful, not only to students of surveying, but also to acting lawyers and surveyors everywhere.

Elementary Commercial Geography. By Dr. H. R. Mill. Revised by Fawcett Allen. Pp. xii + 215. (Cambridge University Press, 1914.) Price 1*s*. 6*d*. net.

Dr. Mill's primer of commercial geography was published first in 1888, and is well known to all teachers of the subject. It is sufficient to say of the latest edition that it has been revised thoroughly by the aid of the latest official publications, and is enlarged by additions to part i., and by more detailed descriptions of countries which have shown recent commercial development.

LETTERS TO THE EDITOR.

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

The Funafuti Boring.

It was with great pleasure that I read the clear statement of Prof. J. W. Judd (Nature, March 12) in reply to the letter of Prof. E. B. Poulton (February 26) upon this subject. Especially welcome was his definite statement that all idea of solution of calcium carbonate being the causative factor of lagoon formation was negatived by the study of the bore.

But I would direct a caution to those who might be inclined to read into Prof. Judd's letter a vindication of the correctness of Darwin's theory of atoll formation.

Suppose it is definitely proved that an atoll such as Funafuti is established upon a basis which has certainly undergone a movement of sinking. Such a finding can only establish the "validity" of a statement that a sinking basis may become the site of atoll development; it cannot establish the "validity" of a theory which demands this sinking as the *cause* of the development of the peculiarities of atoll growth; especially in the face of the definite knowledge that typical atoll growth may be established upon a basis which shows either, no evidence of sinking, or actual evidence of rising. It is upon this point that I fear the recent correspondence may mislead.

One other question arises: Has it been definitely proved that the site of Funafuti atoll has undergone a movement of sinking?

A bore made upon the extreme windward edge of an atoll some ten miles in diameter has so inherent a probability of penetrating a talus slope, that the most rigid proof should be furnished of its having penetrated anything else. This proof is, I think, not forthcoming.

The lagoon bores are not sufficiently deep to establish, beyond dispute, the supposition that there has been a movement of sinking. The statement of Prof. Judd would leave quite an opposite impression, for he says that the lagoon bore extended "to a depth of 100 ft. below the limit of growth of the reef-forming corals." The lagoon bores extended to 36 and 41 fathoms below the surface of the water. It is obvious that to make Prof. Judd's statement correct he must allow the reef-builders only $24\frac{1}{3}$ fathoms as their bathymetrical limit. But $24\frac{1}{3}$ fathoms is not the "lowest depth at which, as all naturalists agree, reef-forming corals can flourish."

It is only necessary to mention the dredgings of Basset-Smith on the Lizard and Macclesfield Banks in which twelve species of typical reef-forming corals were obtained from between 31 and 45 fathoms. On open oceanic banks, far from any shore line from which suspended matter may be carried in the water, it is possible that even this may not represent the bathymetrical limit of the true reef-builders; but it is enough that we have positive knowledge of their presence at depths exceeding that of the Funafuti lagoon bores to negative any idea that these bores can prove a downward earth movement. Atoll formations are developed in areas in which upward earth movements are evident; they are also developed in areas in which downward earth movements are evident (though the Funafuti bores cannot be accepted as proving it); and in neither case can such movement be invoked as the cause of their peculiar features. The Funafuti bores showed that "solution" was not the cause of lagoon formation; they did not show that "subsidence" was the cause. It is the study of the coral zooid and the coral colony that alone can reveal the picture of atolls caused by "sedimentation." F. Wood-Jones.

We are quite ready to admit that the evidence obtained at Funafuti does not prove that *all* atolls are formed by subsidence. A stationary volcanic bank, eroded down to the level at which reef-forming corals could begin to flourish, would serve as well for the basis of an atoll as a sinking island; this was well pointed out by the late Admiral Wharton. So, too, would a deeper bank which had been raised to a similar level by the raining down upon it of pelagic organisms, *if it can be shown that such action is capable of producing any considerable thicknesses of rock.* And there are other conceivable ways in which atolls may arise, as was fully admitted by Darwin in his correspondence with Semper.

We claim, however, that Funafuti proves that atolls can be formed by subsidence from the following facts. The upper part of the main boring, as well as several subsidiary borings, show the existing reef to consist of corals in their position of growth, their interstices being filled with broken fragments of coral mingled with smaller organisms. Now, right down to the extreme depth reached, the cores were of precisely similar character; they showed corals in the position of growth surrounded by detritus and small organisms. Thus the hypothesis of a talus—which, so far as I know, was only suggested after the boring was found not to reveal a substratum of foreign rock—falls to the ground.

Although species of corals belonging to genera which are reef-forming have been found at considerable depths, the luxuriant growths of coral, necessary for building up a great reef, have never been shown to take place below 20 to 25 fathoms. This was a conclusion that was certainly accepted by the late Prof. Alexander Agassiz, from the results of his wide experience, as it has been by so many other naturalists. The ingenious method employed in boring in the middle of the lagoon of Funafuti did not admit of large cores being brought up, but the borings were stopped by hard coral-masses, the fragments obtained from these indicating that they belong to reef-making forms. It is fair, therefore, to maintain that the lagoon borings at Funafuti afford valuable evidence in support of that obtained by the main boring.

J. W. Judd.

Zoological Classification.

Zoological classification of the present day is unsatisfactory, and the reason is not far to seek. This condition has resulted from the unnecessary multiplication of genera.

The real object of classification is being lost sight of. The objects aimed at in a classification may be put briefly as follows:—(1) To give to each animal a name, by which it will be known internationally, and (2) to give to animals which resemble one another the same name.

The unit-group of animals bearing the same name is the genus. How large may the genus be? There are at present independent genera which have been created out of a formerly existing single genus. Has the diagnosis of the species been rendered simpler by breaking up the genus, and by giving to each subgenus a new name? Certainly not in several cases.

The subdivision of the older genus has resulted from the more detailed examination of the various species. Such investigation cannot be too minutely carried out, for it is necessary both from the morphological and the diagnostic point of view. But the mistake has been made of giving to the new groupings of species thus revealed names which are so dissimilar from that of the orginal genus, and from each other, as to hide the genus-relationship. The latter is shown when the genera are grouped as a family.

The subdivision of the animal kingdom into groups that receive independent names should not be carried further than is necessary to ensure ready diagnosis of the species. When carried beyond that point the classification is weakened.

What is required at present is the extinction of probably half at least of the genera. The present family-group should in many cases be the genus.

H. CHAS. WILLIAMSON.

Marine Laboratory of the Fishery Board for Scotland, Aberdeen, March 23.

The Dublin Gorilla.

LIVE specimens of the gorilla are still rarities in British zoological gardens, and it is believed that except for one that has lived for several years at Stuttgart, there is no example at present to be seen on the European continent. A few notes on a young female —probably about a year old—that has now lived for three months in the ape-house of the Royal Zoological Society of Ireland, in Dublin, may therefore be of interest to readers of NATURE.

This little ape—"Empress" is her name—was brought to Europe in company with a young male chimpanzee; in consequence of this companionship she is much tamer and livelier than captive gorillas usually are. In the constant sports which the two young creatures enjoy, the chimpanzee is the more active and spirited, frequently cuffing the gorilla playfully or dragging her along the floor of the house. The gorilla, however, is able to hold her own, and has already developed the habit of drumming on her chest as a challenge; usually she is good-tempered both to her companion and to human visitors. She often climbs leisurely but confidently to the top of the house. The photograph (by Mr. W. N. Allen) shows the little ape in a characteristic attitude, and brings out the distinctive shape and pose of the leg and hindquarters. Her eyes are very expressive, and her almost black face is a great contrast to the pale pink skin of her companion chimpanzee. Both the apes have completely recovered from an epidemic cold that ran through the house in February, and it is hoped that "Empress" may survive in the Dublin Gardens for several years.

G. H. CARPENTER.

Royal College of Science, Dublin.

A Property of Chain-Fractions.

FOR convenience, let $(1;\ a, b, c, \ldots)$ mean the chain-fraction of which $1/a$ is the first convergent, and a, b, c, etc., are the partial quotients. Consider all such fractions which have no partial quotient greater than 9: the greatest of these is the periodic fraction $(1;\ \dot{1}, \dot{9})$, and the least is $(1;\ \dot{9}, \dot{1})$. We have,

$$\alpha=(1;\ \dot{1}, \dot{9})=(-9+\sqrt{117})/2=0{\cdot}9083,$$
$$\beta=(1;\ \dot{9}, \dot{1})=(-9+\sqrt{117})/18=0{\cdot}1009,$$

and any proper fraction outside the limits (α, β) will have at least one partial quotient greater than 9. (The converse is not true.) More generally, one partial quotient at least will be greater than an assigned integer n, if the chain-fraction represents a quantity outside the interval determined by the positive roots of the equations:—

$$\alpha^2+n\alpha-n=0, \quad n\beta^2+n\beta-1=0.$$

As n increases, α becomes more and more nearly equal to 1, and β more and more nearly equal to 0. The curious point is that if we take a proper fraction sufficiently near to 1 or zero, its chain-fraction expansion must contain a partial quotient greater than any integer assigned beforehand, and we can actually (when n is given) assign intervals containing such fractions *and no others*. For instance, when $n=9$, the intervals are

$$\{1, (-9+\sqrt{117})/2\} \text{ and } \{0, (-9+\sqrt{117})/18\}.$$

Thus 0·9089 is within the first of these intervals, and its expansion is $(1;\ 1, 9, 1, 42, \ldots)$.

G. B. MATHEWS.

New Units in Aerology.

IN NATURE of March 19, p. 58, Prof. McAdie discusses the question of the new units in aerology, and says that now is the time to agree upon a logical and available system, considers the megabar atmosphere the more appropriate, and thinks that some of the readers of NATURE may suggest something better.

I have not the ambition to respond to the last suggestion, but, in order to avoid confusion in the future, I beg to direct attention to what has been done in this respect very recently. According to an official report, M. Pérot has presented to the French Minister of Commerce a report upon the reform of the legalised measures and weights. In this we find among the derived units the *Newton* as a unit of force $=\text{Kg m/sec.}^2$, which equals 10^5 dynes. From this is derived another new unit, *Pascal*, as a unit of pressure, 10 Newtons per sq. cm. (10 Newtons = 1 megadyne). I may add that the *Calorie* is proposed at 15° and 1·02 Pascal (=765·1 cm.).

As France may be called the mother-country of the c.g.s. system, the question arises, whether the name *Pascal* might not be substituted for the *modern* megabar (*not* for *ten* absolute atmospheres)?

BOHUSLAV BRAUNER.

Bohemian University, Prague, March 24.

WINELAND THE GOOD.[1]

THE evidence for the pre-Columbian discovery of North America by Norsemen depends essentially on two sagas: the Saga of Eric the Red, the Saga of Thorfinn Karlsefni in Hauksbook; both of which are repeated with modifications in the Flateybook. The dates of the extant MSS. lie between 1300 and 1400 A.D.; the sagas themselves were probably composed about a century earlier; the main event, the discovery of Wineland by Leif the Lucky, occurred in or

[1] "Early Norse visits to North America." By William H. Babcock. Smithsonian Miscellaneous Collections, vol. lix., No. 19. Pp. iv + 214, x plates. (1913.)

about 1000 A.D. Collateral evidence consists mainly in the references by other writers to the events recorded by the sagas, which, it is plain, were regarded as historical narratives.

The numerous vague rumours of a world in the west, as embodied in strange maps and stranger stories, have little bearing on the relatively precise and plain tales of the Norse sea-kings. Those tales which, where not distorted by later fancy, are straightforward as a sailor's log, must be checked by reference to the geographical data recorded in them. This is the most valuable part of the task essayed by Mr. Babcock in his interesting and well-written volume. He is not the first to make the attempt, but the originality and the strength of his attack lie in his reconstruction of the geographical conditions as they probably were nine hundred years ago. Then the seaboard north of the Gulf of Maine was lower than now, whereas south of that point it was higher. The change, which is still in progress, is due to the oscillation of the earth's crust initiated by the withdrawal of the great ice-sheet. By taking this movement into consideration, Mr. Babcock has been able to identify with much plausibility the features and localities mentioned in the sagas.

Let us take only one point in illustration. Karlsefni and his wife Gudrid on their southward voyage saw to the starboard "a bleak coast, with long and sandy shores . . . they called them Wonder Strands, because they were so long to sail by." The interminable sand-dunes of New Jersey and Maryland supply a modern parallel to these cheerless "Furdustrandir," but the voyagers cannot have been further south than Nova Scotia, and no such wonder-strands are found there now. "Conceive," however, says Mr. Babcock, "the Nova Scotia seaboard lowered by the 25 feet or more of its present height, that is, brought down to water-level and dipped a little under—with slight narrowing of the peninsula in its mainland part, and partial obliteration of the eastern side of the now hollow insular terminal part called Cape Breton Island—and you will have something not wholly unlike the long strands of New Jersey or the peninsula east of the Chesapeake, only with the hill country much nearer. It was the first introduction of the surprised northern visitors to the characteristic American coast line."

By such ingenious but not unwarranted use of the scientific imagination does Mr. Babcock identify the various localities of the saga, thus confirming its essential accuracy. The vines that gave a name to Wineland are the fox-grapes of to-day and the apparent wheat "self-sown wherever there were hollows," is interpreted as wild rice, still a conspicuous feature.

It is maintained, then, that Leif Ericsson chanced on America circa 1000 A.D., and coasted as far south as New Jersey; that Eric the Red dispatched Thorfinn and Gudrid three years later, as leaders of a large colonising party; that they passed Helluland (Labrador), Markland (Newfoundland), the Wonder-strands (Nova Scotia), and settled near the mouth of Straumfjord (Bay of Fundy), where Gudrid gave birth to Snorri, the first American-born white man. Disappointed in the hard winter, Thorfinn and a party sailed further south about as far as Mount Hope Bay, but were driven back by Indians. After another winter at Straumfjord, all returned to Greenland.

THE IMPERIAL BACTERIOLOGICAL LABORATORY, MUKTESAR, INDIA.[1]

The Imperial Bacteriological Laboratory, situated at Muktesar in the United Provinces, has been established, and is maintained for the investigation of the diseases of stock in India, and for the preparation of anti-sera and vaccines used for the control of epidemic diseases among animals. The history of the laboratory dates from 1890, when Dr. Lingard was appointed Imperial Bacteriologist, and for some years the work in connection with the diseases of animals in India was carried out at Poona. It was decided, however, to establish a separate institution for this purpose in the hills, and in 1895 a laboratory and a few additional buildings were completed. This first laboratory was destroyed by fire in 1899. The re-building was taken in hand at once, and the present laboratory, much larger than the original structure, was erected and ready for occupation in 1901. The work of the laboratory has increased very rapidly, and it was found necessary to add a wing to the main building four years ago. In addition to the large laboratory there are three smaller buildings for the study of separate diseases, and other buildings for the accommodation of animals, post-mortem examinations, etc., have been added from time to time.

One of the earliest problems to be studied at Muktesar was the preparation of a prophylactic for rinderpest. In 1896 Koch visited Muktesar, and demonstrated his bile method of inoculation against rinderpest. An anti-serum for the disease was first prepared in India by Lingard, and it was first used in field epidemics in 1899, when about 2000 doses were issued. Rinderpest anti-serum is one of the most effective prophylactics known to science, and a striking tribute to its value is to be found in the records of the Muktesar Laboratory. Ten years after its introduction into India half a million doses were issued annually. In 1910 improved methods for the preparation of the serum were discovered, and in the following year a million doses were manufactured. The serum is now supplied to all the provinces of India, to Burma, Ceylon, and the Native States, to the Federated Malay States, and to Egypt. In addition to rinderpest anti-serum, a serum and vaccine for the control of epidemics of hæmorrhagic septicæmia are prepared, as well as a vaccine for black quarter and a serum for anthrax. About 20,000 doses of mallein are issued annually. Pathological specimens are examined, and instruction is given to native veterinary graduates in the practical application of serum and vaccines.

[1] "A Description of the Imperial Bacteriological Laboratory, Muktesar: its Work and Products." By Major J. D. E. Holmes. (Calcutta: Superintendent Government Printing, 1913.)

The officers of the laboratory have carried out numerous investigations in connection with animal diseases. Much of the research work deals with the study of rinderpest, and the results of Dr. Lingard and Major Holmes (the present director of the laboratory) in this field have found practical application in the preparation of rinderpest anti-serum. Investigations on surra were commenced by Lingard at Poona, and continued by him until 1907, when he retired from the service. Holmes directed his attention to the problem of the treatment of surra in equines, and a method has been discovered which, in his hands, has given 75 per cent. of recoveries. The treatment has been successful in animals experimentally inoculated with the disease, and also in cases in which the disease has been contracted naturally. Various other subjects have been studied, and the results of the investigations have been published in scientific journals in India and Europe.

The problem of dealing with infectious diseases of animals in India presents many difficulties which arise from the somewhat peculiar local conditions. Measures of treatment, segregation, and disinfection cannot be imposed without the permission of each individual owner. Formerly a good deal of opposition to serum inoculation for rinderpest was encountered, but this has now almost disappeared, a result which is largely due to the repeated practical demonstrations of the efficacy of serum inoculation in the control of rinderpest epidemics. In dealing with an outbreak of disease it is essential that the measures adopted shall be free from all danger to the lives of the animals treated, and shall in no way interfere with their work. Under these conditions serum therapy has proved to be the safest and most efficient method of operation. Dead vaccines are also used as a preventive measure in districts where disease is seasonally prevalent. Vaccination by means of living or attenuated organisms is not practised, except in the case of black quarter.

A consideration of the subject matter of this pamphlet, and a study of the thirty full-page illustrations, shows that a successful attempt has been made to deal with a subject of great economic importance, viz., the health and well-being of the stock of a great agricultural country. The rapidity of the progress made, since the establishment of the laboratory some twenty years ago, is remarkable, and especially so when one considers the nature of the difficulties which have been encountered.

Percival Hartley.

PROF. J. H. POYNTING, F.R.S.

On the evening of Monday, March 30, surrounded by his family, John Henry Poynting passed quietly away. A memorial service was held in Birmingham on the Thursday following, and was attended by representatives of many universities and learned societies, including Sir J. J. Thomson, Sir Joseph Larmor, Dr. Glazebrook, Sir William Tilden, Prof. W. M. Hicks, Dr. W. N. Shaw, and of course by many colleagues and councillors of the University in which he occupied a chair, as well as by a large number of private citizens and friends. For he was a man universally beloved.

He was born on September 9, 1852, at Monton, near Manchester, son of the unitarian minister of that place. His first education was at home, but the years 1867 to 1872 he passed at Owens College, Manchester, graduating B.Sc. at the London University, and proceeding, in 1872, to Trinity College, Cambridge, where he was bracketed third wrangler in 1876.

He was then appointed demonstrator at Owens College by Balfour Stewart, and began a life-long friendship with Sir J. J. Thomson, who was at that time a student. In due time Poynting became a fellow of Trinity, and in 1880 was appointed to the professorship of physics at Birmingham, which he held to the day of his death.

The four first professors of the Mason College, which was opened by Huxley in 1880 (who delivered, on this occasion, a notable address, reprinted as the first of his collected essays), were Sir Wm. Tilden, Prof. M. J. M. Hill, Dr. T. W. Bridge, who died a few years ago, and Poynting. In this same year Poynting married Miss M. A. Cropper, daughter of the Rev. J. Cropper, of Stand, near Manchester. In 1887 he received the Sc.D. of Cambridge, and in 1888 the fellowship of the Royal Society. In 1891 the Adams prize was awarded to him, and in 1899 he presided over Section A of the British Association at Dover. This meeting was memorable for the clear discovery of the separate existence of electrons, which was announced to Section A by Sir J. J. Thomson on an occasion when many members of the French Association, meeting simultaneously at Boulogne, had come over for friendly fraternisation.

In 1905 Poynting became president of the Physical Society, and was awarded a Royal medal by the Royal Society "for his researches in physical science, especially in connection with the constant of gravitation and the theories of electrodynamics and radiation." In this brief summary an immense amount of work is referred to. The work for which he is locally best known was his determination of the Newtonian constant of gravitation by the very accurate use of an ordinary balance with an adjustable mass under one or other of the pans—a determination which is popularly called "weighing the earth." His account of it appears in the *Phil. Trans.* for 1891. It is a classical memoir of its kind, and very instructive to the physical student, but the papers on electrodynamics eclipse it in value. These were "communicated" to the Royal Society in 1884 and 1885 respectively, their titles being "On the Transfer of Energy in the Electromagnetic Field," and "On the Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field."

The memoir on the transfer of energy aroused universal attention. The paths by which energy travels from an electromotive source to various parts of a circuit were displayed, and their intricacies unravelled, for the first time; *identity* of energy might legitimately be urged as a supplement to *conservation*; and it is to these papers that we owe that fundamental generalisation, connecting mechanical motion with electric and magnetic forces, which is known all over the world as "Poynting's Theorem."

The work on radiation appeared partly in the *Phil. Trans.* for 1904 and partly in the *Phil. Mag.* for 1905. In these memoirs the tangential pressure of radiation is analysed and demonstrated; and it is shown, both theoretically and experimentally, that a beam of light behaves essentially as a stream of momentum, and gives all the mechanical results which may thus be expected, though of a magnitude exceedingly minute. Nevertheless, he goes on to show that these radiation-pressures, however small, are of much consequence in astronomy, and have many interesting and some conspicuous results. A noteworthy part of his radiation memoirs, however, is independent of considerations of pressure or momentum, and gives a means of determining the absolute temperatures of sun and planets, and of space, in a singularly clear and conclusive manner.

It is impossible, in a brief notice like this, to do justice to these great treatises, or to the rest of Poynting's scientific work; it must suffice to mention the titles of a few of his other papers:—"Change of State Solid-Liquid" (*Phil. Mag.*, 1881); "A Double Image Micrometer" (*Monthly Notices, R.A.S.*, 1892); "Osmotic Pressure" (*Phil. Mag.*, 1896); "On a Simple Form of Saccharimeter" (Proc. Phys. Soc., 1881).

Among his publications is a series of text-books on physics, written in conjunction with his friend, Sir J. J. Thomson; but he has also produced smaller and more popular books, one on "The Pressure of Light" (S.P.C.K.), and one on "The Earth" (Camb. Univ. Press). He also took an interest in statistical science, and wrote on "Fluctuations in the Price of Wheat," and on "Drunkenness Statistics of Large Towns."

His public spirit was shown by his accepting the position of a justice of the peace.

He took some interest also in the philosophical aspects of physical science, and his help is acknowledged by Prof. James Ward in connection with the publication of a series of Gifford Lectures. Poynting was strongly inclined, almost unduly, to limit the province of science to *description*, and to regard a law of nature as nothing but a formulation of observed similarities. He wished to abolish the idea of *cause* in physics. In some of this he may have gone too far, but his rebellion against an excessive anthropomorphism which had begun to cling around the notion of natural laws, as if they were really legal enactments to be obeyed or disobeyed by inert matter almost as if it possessed will-power and could exercise choice, some substances being praised as good radiators while others are stigmatised as bad—most gases being admittedly unable to reach a standard of perfection held out to them as Boyle's law, though a few of excessive merit might surpass it,—Poynting's revolt against this kind of attitude to laws of nature, though doubtless more than half humorous, was in itself wholesome. His philosophic views may be read, as a Presidential Address to Section A, in the Reports of the British Association for 1899.

But I must not delay further on his scientific work; the man himself was even more than his work. When the Mason College became the University of Birmingham Poynting was elected Dean of the Faculty of Science; in that capacity his quiet wisdom and efficiency were very manifest, and keen was the regret of all his colleagues when, some twelve years later, failing health necessitated his yielding this office to another. His judgment was as sound as his knowledge, and his conspicuous fairness endeared him to colleagues and the members of his staff. By the latter it is not too much to say that he was regarded with affectionate veneration; one of them writes to me as follows:—

"As to his character it is impossible to give the right impression to those who did not know him well. I consider him a man of very extraordinary ability, which might have carried him much farther if it had been associated with more self-assertion. But it was largely this modesty and self-suppression which created a very unusual degree of affection in those who had the privilege of knowing him intimately. I always associate him in my mind with Faraday and Stokes."

As a lecturer and teacher he was admirable, and the respect in which he was held by his peers was noteworthy. I am glad to remember that so recently as the last meeting of the British Association, some of the greatest physicists in the world, who were staying with me—Prof. H. A. Lorentz, Lord Rayleigh, and Sir Joseph Larmor—went to his house one evening, and met there in his study Sir J. J. Thomson and Dr. Glazebrook, who were staying with him; thus constituting a remarkably representative gathering, and giving him a pleasure which he remembered to the end of his life.

There is much more that might be said; but let his position in the world of science be what it may, we in the University of his mature life knew him well, and know him best as an admirable colleague, a staunch friend, and a good man.

At the Memorial service, the following true words concerning him were spoken by the Rev. Henry Gow, who knew him well:—

We remember that he did work to make him famous throughout the world of science which gave him a high place amongst the discoverers of truth; but we remember much more than that. We remember how he loved life, how interested he was in little things, how he delighted in children, in flowers, and in birds; what confidence and affection he inspired, how free he was from claims of self and from uneasy egotism; how much happiness he felt and gave. We remember his wise judgments, strong character, cheerful courage, his delightful humour, and a certain peaceful beauty and childlike joyousness of spirit behind all his multifarious gifts. He rejoiced to be the friend as well as the teacher of the young. He kept his heart free from all bitterness and disillusion which come so often to us in our later years. He knew and felt always how beautiful and great a thing it was to be alive.

OLIVER J. LODGE.

NOTES.

DR. G. T. BEILBY, Prof. A. Keith, F.R.S., and Mr. J. Swinburne, F.R.S., have been elected members of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

By the death of Mrs. Huxley on March 5, in her eighty-ninth year, another link with the scientific society of the latter half of the nineteenth century has been snapped. All who had the happiness of knowing Huxley intimately are aware of the reliance which he at all times reposed on the advice and judgment of his lifelong helpmate. Not only in all domestic concerns, but in questions of literary criticism and even of scientific procedure, he never took a step without consulting her, and her wide knowledge and keen literary instincts made her aid invaluable to him. As is well known, the young surgeon of the *Rattlesnake* found a kindly welcome in the house of Mr. W. Fanning, a merchant in Sydney; and the half-sister of the merchant's wife, Miss Henrietta Heathorn, who had come out to Australia four years earlier, won his affections, though eight years had to elapse before the marriage could take place. Strange to say, Mrs. Huxley's health was a constant source of anxiety to her husband; he believed that an Australian medical man had so injudiciously treated a complaint from which she suffered as to have fatally undermined her constitution, but, nevertheless, she has survived Huxley himself by nearly twenty years. Mrs. Huxley wrote some very striking and thoughtful poems, nonsense verses, for the amusement of her children and grandchildren, and laughable stories, illustrated by one of her gifted daughters, with the same object; she will, however, be best remembered by the little work containing judiciously selected passages from her husband's writings, the admirable "Aphorisms and Reflections from the Writings of T. H. Huxley."

THE HON. FRANCIS ALBERT ROLLO RUSSELL, whose death on March 30 we announced with regret last week, was the third son of the first Earl Russell. He was born on July 11, 1849, and was educated at Harrow and at Christ Church, Oxford. As a youth he became interested in meteorological phenomena, and when about fifteen or sixteen years of age he began keeping records of the weather, especially of clouds and optical phenomena. He became a fellow of the Royal Meteorological Society in 1868, and served on the council from 1879 to 1892, and again in 1914, and was a vice-president in 1893–94. He was a fellow of the Royal Sanitary Institute, and served on the council in 1881–82, and again in 1889–92. Mr. Russell was the author of several works and papers on meteorological subjects, and also on matters connected with public health. He took a great interest in the question of London fogs, and was an advocate for the abatement of coal smoke. In conjunction with the late Mr. Douglas Archibald, he made a report to the Royal Society on the unusual optical phenomena of the atmosphere, 1883–6, including twilight effects, coronal appearances, sky haze, coloured suns and moons, etc., which were due to the volcanic eruption of Krakatoa. For his memoir, "The Atmosphere in Relation to Human Life and Health" (148 pp.), which was submitted to the Hodgkins Fund prize competition of the Smithsonian Institution, he was awarded honourable mention with a silver medal. Among his other works may be mentioned "The Spread of Influenza: its Supposed Relation to Atmospheric Conditions" (1891), "On Hail" (1893), and "The Early Correspondence of Lord John Russell," which was published last year.

THE seventieth birthday, on March 25, of Prof. Adolf Engler, the director of the Royal Botanic Garden and Museum at Dahlem, near Berlin, was celebrated in the presence of many eminent German and foreign botanists, by several functions. On the day itself, Prof. Lindau spoke on behalf of the scientific staff of the garden and museum. Prof. Pax, rector of the University of Breslau, with Profs. Diels and Gilg, as its editors, presented to Prof. Engler a copy of the *Fest-Band* of Engler's "Botanische Jahrbücher." The volume forms a supplement to the fiftieth volume of this well-known publication, and consists of more than forty illustrated contributions, largely from his pupils. The volume will be a lasting memorial of appreciation of Prof. Engler's botanical position, not only in Germany, but also in both hemispheres. As a further mark of this appreciation, Prof. Haberlandt presented Prof. Engler, on behalf of hundreds of subscribers, with his life-size marble bust, the work of the sculptor, A. Manthe, while Prof. Wittmack (to whom we owe these particulars, and the celebration much of its success) read the congratulatory address of the Deutscne Botanische Gesellschaft. Following similar addresses from the Vereinigung für angewandte Botanik, and from the Freie Vereinigung, an album of views of all the meeting places of the systematists was presented. Prof. Warming spoke on behalf of the foreign botanists. The presidents of the German Horticulture and of the Dendrological Societies added their felicitations, and it was announced that Prof. Engler had been made an honorary member of several learned societies in Germany, Russia, and other countries. On March 26 there was a banquet at which the official world was represented; and on March 27 the monthly meeting of the Deutsche Botanische Gesellschaft was converted into an "Engler" meeting, and Prof. von Wettstein gave, by special invitation, a lecture on the phylogenetic evolution of the Angiosperm flower.

IN connection with the establishment of a meteorological observatory at Agra for upper-air observations, the *Pioneer Mail* states that the Government of India has decided that the observatory shall be called the "Aerological Observatory, Agra," and that Mr. J. H. Field, Imperial meteorologist, while in charge of this work shall be designated the director of the observatory, and Mr. W. A. Harwood, the assistant-director.

At the suggestion of Mr. R. H. Tiddeman, president of the Yorkshire Geological Society, arrangements are being made by the society to call a conference next autumn, in Leeds, to consider the question of the glacial geology of the north of England. The conference will last a week, and in addition to papers and discussions, excursions will be made during the day to various centres of importance in connection with the glaciation of the north of England. Glacialists from all parts of the country will be invited to attend. A committee has been elected to make all the necessary arrangements.

Through the generosity of M. Spendiaroff, of St. Petersburg, the International Geological Congress presents at each session a prize amounting to about 450 roubles (47*l.*) for the best work in some specified field of geology. The next prize will be awarded at the session in Belgium in 1917 for the best work in petrography giving new light on the general problems of the science. Two copies, at least, of any work presented for the competition must be sent to the general secretary of the last congress, Mr. R. W. Brock, Deputy Minister of Mines, Ottawa, Canada, at least one year before the next session.

The septennial award under the Acton Endowment has this year been made by the Royal Institution to Prof. C. S. Sherrington, Wayneflete professor of physiology in the University of Oxford, for his work entitled "The Integrative Action of the Nervous System," being a synopsis of his elaborate paper published in the Philosophical Transactions of the Royal Society on experiments in examination of the peripheral distribution of the fibres of the posterior roots of some spinal nerves. Previous Actonian awards have been made to Sir George Stokes, Miss Agnes M. Clerke, Sir William and Lady Huggins, and Madame Curie, for achievements in the field of physical science. Prof. Sherrington is the first investigator in experimental biology to receive this distinction for the third of a century.

We regret to learn that the recent fire at Wellesley College, Massachusetts, though happily unattended by loss of life, destroyed the results of several years of research work. For the last six years Prof. Marion E. Hubbard has been investigating the problem of variation and heredity in beetles. The disaster swept away in a few moments all her notes and specimens, as well as a valuable original apparatus she had constructed for the purpose of her observations. Prof. Alice Robertson, head of the department of zoology, similarly lost all the specimens and notes relating to a collection of bryozoa dredged up by the *Albatross* expedition. Prof. C. B. Thompson, of the same department, has lost the results of similar work on dredgings bv the Bureau of Fisheries and the University of California, together with the memoranda of three years' experiments on the brains of ants and a collection of 4000 slides which had taken eight years to prepare.

The programme has just been issued of the annual meeting of the Iron and Steel Institute, to be held on Thursday and Friday, May 7–8. On May 7 the retiring president, Mr. Arthur Cooper, will induct into the chair the president-elect, Mr. Adolphe Greiner; the Bessemer gold medal for 1914 will be presented to Mr. Edward Riley; the president will deliver his inaugural address; and a selection of papers will be read and discussed. On May 8 the Andrew Carnegie gold medal (for 1913) will be presented to Dr. T. Swinden, the award of research scholarships for the current year will be announced, and other papers will be read and discussed. Among the papers that are expected to be submitted for reading and discussion are:—"The Forms in which Sulphides may Exist in Steel Ingots," Prof. J. O. Arnold and G. R. Bolsover; "The Hardening of Metals, with Special Reference to Iron and its Alloys," Dr. C. A. Edwards and Prof. H. C. H. Carpenter; "Influence of Molybdenum upon the Corrodibility of Steel," Dr. J. N. Friend and C. W. Marshall; "The Magnetic and Mechanical Properties of Manganese Steels," Sir Robert A. Hadfield and Prof. B. Hopkinson; and "A New Reagent for Etching Mild Steel," Dr. W. Rosenhain and J. L. Haughton.

The President of the Scientific Association of Rhodesia regrets in his annual address for 1913 that no attempt has been yet made to organise an anthropological survey of the State. He suggests the preparation of tribal and linguistic maps as a preliminary measure. Some good work is being done by the members under the difficulties which attend research in a new country. The report publishes two excellent ethnological and sociological papers on the Matabele, by Mr. P. Nielsen, and the people of the Zambezi valley, by Mr. C. I. Macnamara, which give valuable accounts of tribal organisation, initiation ceremonies, and marriage rites, which deserve the attention of anthropologists.

The fine collection of glacial boulders now preserved in the grounds of Messrs. Cadbury, at Bournville, Birmingham, is described by Prof. C. Lapworth in part ii., vol. xviii., of the Proceedings of the Cotteswold Naturalists' Field Club for 1913. After describing the advance of the ice-sheet into the midlands, and the numerous boulders conveyed by its action into the Birmingham district, the writer states that the collection at Bournville consists of masses of dark igneous Plutonic rock, usually known as felsite or andesite, identical with the rock which forms a large part of the Arenig mountain ranges, several miles west of Bala Lake, in the basin of the river Dee, North Wales, and fully fifty miles, as the crow flies, from Bournville.

To the March *Zoologist* Col. C. E. Shepherd communicates the first part of an article on methods of determining the position of the auditory sacculus and its contained otoliths in various groups of fishes.

In an article on the effect of geographical distribution on the development of species, published in the March number of the *American Naturalist*, Mr. A. C.

Chandler enunciates a law that as the distributional area of any given group of animals increases, the number of species increases in proportion to the genera, that of genera to the families, and so on. The theoretical explanation of this law involves the consideration of problems relating to evolution and species-development.

Three important additions to the Natural History Branch of the British Museum are recorded in the March number of the *Museums Journal*, namely, a series of more than 900 zeolites collected and presented by Mr. F. N. A. Fleischmann, a collection of 800 specimens of plants made in the Eket district of Southern Nigeria by Mr. and Mrs. P. A. Talbot, by whom they were presented, together with descriptions and coloured sketches, and, lastly, a collection of more than 10,000 specimens of Hymenoptera (including 1500 types), brought together by the late Mr. P. Cameron, and purchased from his executors.

The most interesting feature in the March number of the New York Zoological Society's Bulletin is Mr. Townsend's account of the capture and transport of the bottle-nosed dolphins, or porpoises (*Tursiops tursio*) in the New York Aquarium. There is a regular fishery of these cetaceans at Cape Hatteras, N. Carolina, and in November last a small "school" of them was captured and dispatched to New York in special water-tanks. Nine reached their destination in safety, and of these five were alive and in excellent health at the time the article was written. They are kept in a salt-water pond of 37 ft. in diameter by about 7 ft. in depth, and constitute a unique and highly attractive exhibit.

Amphibians and reptiles loom large in the March number of Douglas English's *Wild Life*, Mr. E. G. Boulenger communicating an exquisitely illustrated article on some of the well-known species of European toads, while in a second he figures the first living example of the saddle-backed giant tortoise (*Testudo abingdoni*), of Abingdon Island, Galapagos group, received alive in this country. In a note regarding other giant species the author mentions that about 1760 no fewer than 25,000 of these chelonians were exported from Rodriguez to Mauritius for food in a single year. Little wonder that the species of the former island soon became exterminated. In connection with giant tortoises, it may be mentioned that remains of an extinct species from the Pleistocene of Minorca are described by Miss Bate in the March number of the *Geological Magazine*.

A new serial, of the first number of which we have received a copy, has been started at Buitenzorg, under the editorship of Dr. J. C. Koningsberger, and published by the Department of Agriculture, Industry, and Commerce, with the title of "Contributions à la Faune des Indes Néerlandaises." It is specially intended for papers emanating from the Zoological Museum and Laboratory of Buitenzorg, and the Biological Station at Batavia, which have hitherto appeared in another local publication. The new issue appears, however, as a section of the well-known "'s Lands Plantentuin," dating from 1817. Its contents include an article by Dr. C. P. Sluiter on holothurians collected by Mr. P. N. van Kampen in the Malay Archipelago, and a list of chelonians from the Dutch East Indies in the Buitenzorg Museum.

In a recent number of the *Memorias do Instituto Oswaldo Cruz* (vol. v., part 2), a memoir, illustrated by beautiful coloured plates, is published by Drs. Aragao and Vianna on the disease known as *Granuloma venereum*. The authors deny that a treponeme is the cause of the disease, which is quite distinct from syphilis. They associate the disease with a peculiar bacterium occurring in the cells of the granulomatous tissue. The most striking characteristic of this organism is the possession of a peculiar capsule, for which reason they propose to put it in a distinct genus, Kalymmabacterium (or Calymmatobacterium; the name is spelt in both these ways in the same paragraph). The authors have obtained very remarkable success in the treatment of this disease with injections of tartar-emetic; they state that this treatment has effected a complete cure in every case treated by them, and the photographs given of cases before and after treatment are quite astounding. Full descriptions are given of a number of cases and of the progress of the treatment. Incidentally, it is mentioned that injections of tartar emetic have been found most efficacious in the treatment of leishmanioses in Brazil.

The Carnegie Institution of Washington has published together a paper by Prof. W. E. Castle, "Reversion in Guinea-pigs and its Explanation," and one by C. C. Little, "Experimental Studies of the Inheritance of Color in Mice" (Publication No. 179, issued September, 1913). Prof. Castle shows that some red guinea-pigs when mated with black give blacks, black being dominant, but that other apparently similar reds when mated with blacks give agouti. A series of breeding experiments proves that the cause of the difference is that some reds contain a factor which brings about striping in the hair. It has no effect in the red, from which black pigment is absent, but black, in the presence of the striping factor, becomes agouti. Mr. Little's paper adds some new and probably valuable ideas to the already extensive literature of coat-colour in mice. He points out that yellow, brown, and black pigment are produced by three successive stages of oxidation of a chromogen. He suggests that albinos lack the factor *Y* (yellow) which produces the first stage, and that the higher factors *Br* (brown) and *B* (black) are then unable to act. Brown is produced by the presence of *Y* and *Br*, black by *Y*, *Br*, and *B*. Yellow, which in all the cases he has used is dominant to other colours, is caused by a factor inhibiting the action of *Br* and *B*. There are in addition two classes of "distributive" factors. One of these causes full development of pigment; its absence causes dilute colour. Another is necessary for full development of *Br* and *B*; in its absence the mice are pink-eyed with pale-coloured hair. Both these factors are somewhat variable in intensity. The other pair of distributive factors are that for the agouti barring of the hair, and that which more or less completely inhibits *Br* and *B*, giving dominant yellows. The question of piebalding is also dealt with, and many pages of tables of experimental results are included.

The unexpected discovery of hot springs and evidences of recent volcanic activity in Spitsbergen is described and illustrated by A. Hoel and O. Holtedahl in *Naturen* for January, 1913. The occurrences are in Wood Bay, on the little visited north coast of the main island. The springs have formed characteristic travertine basins, in which a species of Chara is recorded, with a moss and twelve algal species which are equally new to the high arctic flora. The characteristic forms in the moving soils of Spitsbergen, with their walls of stones set in circular cracks, are described by W. Meinardus in the *Sitzungsberichte des Naturhistorischen Verein der preuss. Rheinlande u. Westfalens*, 1912 (published 1913), C, p. 1. A useful bibliography is appended. B. Högbom points out the various features in Spitsbergen that indicate the dryness and the desert-character of present conditions in the island (Bull. Geol. Institution of the Univ. of Upsala, vol. xi., p. 242), and A. Smith Woodward describes Lower Triassic fish-remains from Sassen Bay in the same volume.

The Messina earthquake of December 28, 1908, originated in two foci, both beneath the Straits of Messina, one at its northern entrance, the other between Reggio and Messina. Almost exactly four years later, on December 22, 1912, a strong earthquake occurred, probably within the latter focus. According to Dr. Agammennone, who describes the earthquake in a recent number of the *Rivista di Astronomia*, the shock was not announced by any early tremors; it disturbed an area only 135 miles in diameter; but, though its intensity at Messina was 7 (Mercalli scale), the shock failed to damage buildings erected in accordance with the new regulations.

We are glad to learn that the United States have again decided to send revenue cutters to the vicinity of Newfoundland Banks for the purpose of reporting on the conditions of the ice. The *Seneca* has already taken up her position, and is sending wireless reports to the Hydrographic Office in New York, in addition to which she will make oceanographic observations while cruising in that district. The meteorological charts of the North Atlantic issued by the offices at London and Hamburg for April show that drift ice has recently increased to a considerable extent. Bergs or field ice were seen on or before February 15 nearly so far south as 42° N., and nearly so far east as 41° W. Several ships have had to alter their course, considerably, off the Newfoundland Banks.

The question whether thermometers in the double-louvred "Stevenson" screen, now generally used in this country give true measurements of air temperature has been discussed in *Symons's Meteorological Magazine* for several months past. Mr. W. F. A. Ellison considers that the accuracy that some observers are striving for is fallacious, and that on a sunny day no two adjacent masses of air have the same temperature. An important communication from Dr. John Aitken appears in the March number. He considers that, although the whole mass of air is a mixture of more or less heated patches, the thermometers in the screen in question fairly represent the mean temperature, but that the screen must always read higher than the true temperature, while the sun shines. He points out the important fact that some of the screens in use in the north and south of the country are not similar in construction in all respects.

English readers of Italian scientific journals have often been rather puzzled when they have come across such names as Giuseppe Larmor, Guglielmo Ostwald, or Enrico Poincaré. From a note published in *Isis*, vol. i., part 4, p. 707 (1914), by Aldo Mieli, we are glad to learn that this practice is being discontinued, and he now opens the further question as to how uniformity can be obtained in the spelling of classical names and others possessing different alphabets from ours. Here it is suggested that the nominative case should be universally adopted, and in the case of Greek a uniform system of equivalents for the Greek letters should be adopted. In this list he still adheres to the custom of replacing the Greek *ph* by *f*.

Articles of a semi-popular character *about* mathematics, as distinct from papers *on* mathematics, are not so common as they deserve to be. The February number of the new quarterly, *Isis* (vol. i., part 4) goes a long way to supply this want. Mathematics is represented by three of the five principal articles. M. George Sarton writes on modern tendencies in mathematical history and criticises the recent works of M. Leon Brunschvicg (Paris: Felix Alcan, 1912) and M. Pierre Boutroux (Paris: Hermann, 1913–14), both of which volumes are also reviewed in this number. In Prof. Gino Loria's paper on the glories of British mathematics, which was read at the International Congress of Historical Studies in London in 1913, the author laments the scarcity of literature dealing with the history of English mathematics, and expresses the opinion that many valuable and interesting manuscripts are waiting to be unearthed. Mr. P. E. Jourdain writes on the origin of Cauchy's conceptions of a definite integral and of a continuous function. In addition there are a number of reviews of mathematical books. The subscription to *Isis* is 24 francs per annum, and the offices are at Wondelgem les Gand, Belgium. Messrs. Max Drechsel, of Berne, are agents.

The photographs of the tracks of α and β particles obtained by Mr. C. T. R. Wilson with his cloud apparatus illustrate so well the properties of these radiations, that many teachers will be glad to know the Cambridge Scientific Instrument Company is now producing copies of them in the form of lantern slides. The clearness of the photographs raises the hope that it may be possible to obtain stereoscopic photographs which would enable depth to be estimated, or possibly kinema views which, when run through the lantern slowly, would allow the sequence of events to be followed.

Although the incandescent electric lamp when standardised and used with accurate ammeters has proved the most trustworthy standard of light, the

Bureau of Standards at Washington has selected the Harcourt 10-candle pentane lamp as the best of the gas-flame lamps to serve as a secondary standard. This decision has been arrived at after an extensive test of the various lamps, and the conclusions with regard to the best method of using the standard are embodied in a paper by Messrs. E. C. Crittenden and A. H. Taylor, which appears in the tenth volume of the bulletin. They cover the question of the fuel and the effects of pressure and moisture on the candle-power.

A SUCCESSFUL modification of General Sterneck's pendulum apparatus has been designed and employed by Sig. Vincenzo Reina and Gino Cassinis in the determination of gravity (relative) at Rome, Arcetri (Florence), Livorno and Genoa in Italy, and also at Vienna and Potsdam (*Memorie R. Acc. Lincei*, series v., vol. ix., No. 17, pp. 751–839). In the earlier forms, such, for instance, as those used in the gravimetric survey of the Indian Peninsula, and more recently in Egypt, the pendulum support is a solidly constructed tripod resting on and clamped to a masonry pillar. Although maximum rigidity is aimed at, yet under the alternating strains induced by the swinging pendulums the support is found to be appreciably yielding, and the determination of the effect of flexure constitutes one of the necessary pieces of preliminary work. It is obtained by observing the oscillation of the invariable pendulum induced by a heavier synchronous (variable) auxiliary pendulum swinging in the same plane (method of Schumann). In the Italian modification the means for applying this method is made an inherent feature of the design. The trustworthiness of the correction is increased by securing (1) greater equilibrium in the distribution of parts, (2) that the correction is obtained with the invariable pendulum swinging in the position used in the actual determinations. These improvements are realised by mounting the single perforated agate plate on which the knife edges of the pendulums bear when they are in motion on two consoles, which can be bolted to a vertical surface. Only one invariable pendulum is swung at a time. With this arrangement the effect of flexure is less than one-tenth of that of the tripod type, the maximum correction of nine different groups being -3.9×10^{-7} secs., whilst the minimum was -1.5×10^{-7} secs.

WE have received a reprint of a paper read before the eleventh International Congress of Pharmacy, held at Scheveningen last September, by Prof. Hans Haller, of Leyden, on the application of comparative phytochemistry to systematic botany. Illustrations are given of the growing importance of a knowledge of the chemical substances elaborated by plants in elucidating vexed questions of classification and in throwing light on phylogenetic relations. The field is one which has as yet been little worked, but it will in the future undoubtedly become more and more fruitful.

THE *Società Tipografica Editrice Barese*, of Bari, Italy, announces the forthcoming publication of a series of reprints of scientific and philosophical classics under the title, "Classici delle Scienze e della Filosofia." In some respects this series will resemble the valuable collection already issued by Ostwald in Germany, under the title "Klassiker der exakten Wissenschaften," but the venture will be on an even more ample scale; it will render easily accessible to the student of the historical development of science many classical papers which have hitherto been obtained only with great difficulty. Each volume will contain about 300 pages, and will cost about 3 lire. The whole series is under the general editorship of Messrs. Aldo Mieli and Erminio Troilo. All scientific workers will wish success to this praiseworthy enterprise. The following are specimens of the titles of volumes already issued:—Spallanzani's "Saggio sul sistema della generazione" (1777); Biringuccio's "De la Pirotechnia" (1540), vol. i., and a translation of Descartes's "Principia Philosophiæ." Amongst those to appear at an early date are Francesco Redi's "Esperienze intorno alla generazione degli insetti," Galileo's tracts on motion, and several reprints of the scientific works of Leonardo da Vinci, Volta, Giordano Bruno, and Vico, to mention only a few of those announced as already in the press.

MESSRS. NOVELLO AND CO. have published a second edition of Dr. Jamieson B. Hurry's "Sumer is icumen in." The attractive volume was originally published at the time of the unveiling at Reading Abbey of a memorial tablet, bearing a facsimile of the canon, which, it may be remembered, was written by a monk at Reading Abbey, about the year 1420.

OUR ASTRONOMICAL COLUMN.

COMET 1914*a* (KRITZINGER).—Circular No. 145 from the Central Bureau at Kiel contains the following elements and ephemeris, communicated by Prof. Kobold, deduced from observations on March 29, 30, and 31:—

Elements.

$$T = 1914 \text{ May } 31{\cdot}1816 \text{ M.T. Berlin.}$$
$$\omega = 67^\circ \quad 0{\cdot}95'$$
$$\Omega = 198 \quad 36{\cdot}68$$
$$i = 23 \quad 30{\cdot}86$$
$$\log q = 0{\cdot}09910$$

Ephemeris for 12h. M.T. Berlin.

	R.A. h. m. s.	Decl. ° ′	Mag.
April 8	16 43 30	−3 36·4	10·1
9	46 56	2 53·8	
10	50 24	2 10·2	10·0
11	53 54	1 25·4	
12	16 57 27	−0 39·9	

The ephemeris shows that the comet is reducing its southern declination; it is situated in the constellation of Ophiuchus.

THE NEW SOLAR CYCLE.—The long period of apparent rest which the solar atmosphere has been recently undergoing has now been broken by the comparatively large sun-spot which developed during the course of last week. The sun-spot activity of the last few years has been well summarised in the annual report of the council of the Royal Astronomical Society (*Monthly Notices*, February, 1914). In this we are told that the past year has been a year of minimum activity of sun-spots, more than a century having elapsed since the sun exhibited such complete and prolonged quiescence. The following brief table is gathered from the report above mentioned, and brings out clearly the exceptional nature of the year 1913:—

Year	Days without spots	Mean daily spotted area in millionths	No. of separate groups
1911	183	64	62
1912	246	37	39
1913	320	5	15

It is stated that no year since 1810 has given such a barren record as that just elapsed. The new cycle was indicated last year by two groups in high latitude, the chief criterion for the beginning of a new cycle.

RELATION BETWEEN STELLAR SPECTRA, COLOURS, AND PARALLAXES.—In *Astronomische Nachrichten*, No. 4722, Herr P. Nashan describe the results he has obtained in comparing the colours, spectra, and parallaxes of a number of stars. Dealing first with 101 stars, he divides them first into three classes, α, β, and γ, according as the stars are white, yellow, or red; the parallaxes are also grouped with three divisions as follows:—0·000″ to 0·050″, 0·050″ to 0·100″, and 0·100″ to 0·200″. The comparison shows that the white stars decrease with increasing parallaxes; on the other hand, the red stars increase with increasing parallaxes. The fact that there is a close relationship between the colour and the spectrum of a star has led him to compare the spectra of 246 stars with their parallaxes. The results are best shown as follows:—

Spectrum	No. of stars	Parallax 0″·000–0″·050		0″·050–0″·100		0″·100–0″·150		0″·150+	
		n	%	*n*	%	*n*	%	*n*	%
B	11	7	63·6	3	27·3	1	9·1	0	0
A	28	8	28·5	8	28·5	7	25·0	5	18·9
F	59	19	32·2	22	37·3	15	25·5	3	5·1
G	64	13	20·3	22	34·4	27	42·2	2	3·1
K	70	13	18·6	21	30·0	23	32·9	13	18·5
M	14	3	21·4	2	14·3	5	35·7	4	28·6

Herr Nashan then couples up the B and A stars into a white group, the F and G into a yellow group, and the K and M stars into a red group, and concludes that the relative number of white stars decreases with increasing parallaxes, while the relative number of the red stars increases with increasing parallaxes, a result similar to that obtained with colour alone. The communication concludes with the list of the 246 stars employed, giving their positions for 1900·0, parallax, type of spectrum, and colour.

SERIES LINES IN SPARK SPECTRA.[1]

PREVIOUS work on series lines in spectra has dealt chiefly with lines produced in the electric arc, or in vacuum tubes with discharges of moderate intensity. The lines discussed in the present communication are some of those which are specially developed in the condensed spark, belonging to Lockyer's class of "enhanced lines." The investigation was undertaken in connection with the new lines (λ 4686, etc.) produced in 1912 by passing strong condensed discharges through helium tubes, which always contained an impurity of hydrogen. These lines are of great interest in celestial spectroscopy, and, following Rydberg, they were assigned to hydrogen, to the lines of which they seemed to have a simple relation, while having no apparent connection with those of helium.

[1] Summary of Bakerian lecture delivered at the Royal Society on April 2, by Prof. A. Fowler, F.R.S.

The evidence for assigning the lines to hydrogen, however, was still numerical rather than experimental, and further inquiry was called for, especially in view of the presence of an intermediate set of lines associated with the Rydberg series. A search for other series of this character was therefore instituted in the hope that some generalisation with regard to them might be reached. The well-known spark line of magnesium, λ 4481, was subsequently found to be the leader of a series of this kind, but no relation to other magnesium series was then traced.

The lines of the "4686" series have since become of increased importance, in connection with theories of the constitution of the atom, through the theoretical work of Dr. Bohr, who explains them as being produced during the first stage in the re-formation of helium atoms from which both electrons have been removed by the strong discharges employed. The "4686" and the intermediate series were thus united in a single series of a new type, in which the Rydberg series constant N(=109675) had four times the value associated with hydrogen. A similar modification of the usual formula was found to be applicable to the magnesium series, and also to some lines of calcium, strontium, and barium observed by Lyman in the Schumann region. At this stage a valuable contribution to the investigation was made by the work of Lorenser, from which it results that the enhanced lines of the elements named form groups of series similar to those found in arc spectra. Further calculations have shown that these series are best represented by the Hicks formula with 4N for numerator.

A further experimental investigation of magnesium has resulted in the production of many new enhanced (spark) lines, from which it appears that the "4481" series is the fundamental series of a system of narrow doublets, in which the separation of the pairs is identical with that calculated for the *second* member of the principal series of wider doublets previously known. It has also been shown that the "4481" series consists of very close doublets with constant separation. Two well-defined combination series related to 4481 have also been identified.

From these investigations of enhanced metallic lines it follows that two kinds of series must now be recognised:—(1) Series of the arc type, having Rydberg's "N" for the series constant; and (2) series of the spark, or enhanced line, type, having a series constant equal to 4N. No numerical relations between the two sets of series occurring in the same element have been traced.

The "4686" series produced in helium tubes is of the spark (4N) type, and can no longer be considered to belong to the same group as the Balmer series of hydrogen, which is of the arc (N) type. It is concluded that the lines in question are due to helium, as indicated by Bohr, and it is suggested that they should be designated "proto-helium" lines in accordance with the convenient nomenclature of Lockyer. The "Pickering" lines associated with the "4686" series probably have a similar origin, in which case the series would include intermediate lines nearly coincident with the Balmer lines of hydrogen. Observational evidence on this point is incomplete, but indirect evidence is furnished by the fact that one of the new combination series is related to the 4481 series exactly as the extended Pickering series would be related to the "4686" series of proto-helium.

Dr. Bohr has shown that the slight differences in the observed positions of alternate lines of the "4686" series and those calculated for the principal series of hydrogen by Rydberg are accounted for when his theoretical formulæ are corrected for the mass of the electron (NATURE, October 23, 1913). If the formulæ are correct, the inverse calculation provides a spectroscopic method of determining the mass of the electron. The available observations give the mass of the hydrogen atom in terms of that of the electron as 1836 ± 12, in remarkable agreement with the generally accepted value.

Until other evidence is forthcoming, it may be considered that the line spectrum of hydrogen consists only of the Balmer series, with parallel series in the infrared and extreme ultra-violet. The proto-helium spectrum is of the same simple character, and this simplicity gives the two spectra a special value in theoretical investigations. Bohr's theory implies that arc series in general are produced when only one electron is removed from the atom by the exciting source, and spark series when two electrons are removed.

The change in the character of the series in passing from arc to enhanced lines suggests the possibility of series requiring still greater multiples of the ordinary series constant, but no such series have yet been identified.

PRACTICAL EDUCATION IN SECONDARY SCHOOLS, TRADE SCHOOLS, AND CENTRAL SCHOOLS.[1]

ONE of the most striking features of English education at the present time is the attempt which is being made to give a more practical or vocational bias to the training of boys and girls between the ages of twelve and sixteen years—that is, after the completion of the ordinary primary-school curriculum. So far as day work is concerned, this tendency is operating along two main lines, (*a*) the modification of the traditional secondary-school course by the introduction in some schools of elementary engineering, agriculture, shorthand, typewriting, or of subjects grouped under the general name of "educational handwork" (*e.g.* woodwork, metal-work, domestic subjects for girls); (*b*) the development of schools (central schools, junior technical schools, trade schools) with a pronounced vocational object.

A. *Secondary Schools.*—In the year 1911–12, of the total number (39,726) of new admissions to the secondary schools aided by the Board of Education, no less than 67·7 per cent. came direct from the elementary school. Clearly the great majority of these cannot enter one or other of the learned professions, but must devote themselves on leaving school to some branch of commercial or industrial life. A strong public demand has arisen for a modification of the curricula of these schools so that the education given may be of more direct value to the pupils after leaving school. Employers are demanding better trained assistance; the parents feel that the additional sacrifices they must make in order to keep their boys and girls at the schools after fifteen years of age are not sufficiently justified by the benefits to be derived by their children from an education which is mainly of a literary or classical type. As a result, some secondary schools have specialised to a certain extent, more particularly of course in the higher forms, in engineering subjects, others in science (chemistry, physics, botany, and biology) as applied to agriculture, others in commercial and secretarial work, depending upon the needs and circumstances of the locality. Apparently the results of this specialisation, where it has been attempted, have been satisfactory. The general educational work of the school has gained in interest and vitality by the increased contact with concrete, everyday affairs. Possibly it may help also in checking the exodus of the pupils from the secondary schools at about the age of fifteen, *i.e.* half-way through their full course.

[1] (1) Report of the Consultative Committee of the Board of Education on Practical Work in Secondary Schools [Cd. 6849]. (Wyman and Sons, 1913. Price 1*s.* 9*d.* (2) Report of the Board of Education for 1911–12 [Cd. 6707]. (Wyman and Sons, 1913.) Price 8½*d.* (3) Regulations for Junior Technical Schools in England and Wales [Cd. 6919]. (Wyman and Sons, 1913.) Price 1½*d.*

The Consultative Committee of the Board of Education issued a short time ago a comprehensive and suggestive report upon the development of "educational handwork" of various kinds (woodwork, metal-work, gardening, modelling, and domestic subjects for girls) in secondary schools. The report states (p. 5) that the evidence of the witnesses "leaves no room for doubt as to the necessity and the practicability of giving such work a more definite place in secondary education than it has hitherto occupied, and of associating it so far as possible with the rest of the work of the school." While it is not the function of the secondary school to impart technical instruction, it should provide those of its pupils whose future callings may involve manual work or the utilisation and control of such work with a foundation on which technical instruction may subsequently be built. "Systematic work with the hands is a necessary constituent of a liberal education." To train deftness of hand, although important, is not the sole or even the chief aim of handwork teaching. The principal object is to influence the mind and character of the pupils by developing their common sense, readiness, and adaptability. In addition it brings the work of the school into close relation with the needs of daily life outside the class-room, thus giving school work that reality which is so important for arousing the child's interest. Manual training has a valuable steadying influence upon the over-quick and excitable child, and a stimulating effect upon the child who is naturally slow at abstract mental processes.

The recognition of handwork as a compulsory school subject has been objected to on the ground that it involves the addition of one more item to an already overburdened time-table. Experience shows that a reasonable amount of time devoted to handwork does not lead to any lowering of attainment in other branches of school work, but rather the reverse.

The Committee lays down the following general principles for the teaching of all branches of educational handwork. The encouragement of independence and initiative is of fundamental importance, hence each pupil should be allowed to work at his own pace and be encouraged to select his own work. Classes should be sufficiently small to permit of individual instruction. Constructive practice and theory should go hand in hand. The syllabus should be logical, coherent, interesting, and of a direct culture value. A number of syllabuses which are in actual operation in schools are given in the report. These will be of great value to teachers.

Handwork should be recognised in any general examination scheme for secondary schools. External examinations in this subject are particularly undesirable; the assessment of the progress made by the pupil should be based upon the work done during the course.

The Committee points out that at the present time the educational training, status, and remuneration of handwork teachers are unsatisfactory. These teachers should be on an equality in these matters with their colleagues. This type of teaching should not be handed over to artisans, but to men with a good general education and a special knowledge of educational handwork. The universities should provide increased facilities for this branch of education, and adequate recognition of those who complete successfully the prescribed courses of study.

B. *Central Schools, Junior Technical Schools, Trade Schools.*—In this group of schools the work as a whole has a more pronounced practical or vocational bias than in the secondary schools, this being most marked in the trade schools and least in the central schools. The students in these schools are in nearly every case drawn from the elementary schools. The usual age of admission is twelve or thirteen years, the courses lasting three to four years. The fees are nominal, ranging from 10*s.* to about 2*l.* 10*s.* per annum. There is usually a generous supply of scholarships with maintenance grants awarded by the local education authority.

(1) *Central Schools.*—The last Board of Education report (*i.e.* for 1911–12) states that central schools have been established only in London and Manchester as yet. In London there are thirty-one such schools containing forty-two departments, fifteen for boys, thirteen for girls, and fourteen "mixed"; nineteen of these departments have a commercial bias, sixteen industrial, and seven a "dual" bias. Manchester has six such schools, including three boys' departments, two girls' departments, and three mixed departments.

These central schools are intended to attract at about the age of twelve or thirteen the best boys or girls from the local elementary schools, who have not previously been drafted off by means of competitive scholarships into the secondary schools. The object of the schools is to continue the general education of the pupils and at the same time to prepare the children to go directly at about the age of fifteen or sixteen into business houses or workshops at the completion of the course. The training is to be such, however, that it will not prevent the pupil proceeding by scholarships or otherwise to a place of higher education.

An examination of the curricula of these schools reveals comparatively little difference between them and those secondary schools which have definitely attempted to introduce vocational work into their programme. A typical central school (with a commercial bias) provides throughout the whole course, in addition to the ordinary subjects, such as mathematics, geography, and history, about four hours a week for a modern language, four hours a week to English, science two hours, manual training two hours, and drawing two hours. In the third and fourth years a few hours a week are devoted to shorthand, business correspondence, office routine, and typewriting. In departments with an industrial bias, about ten to twelve hours a week are given to practical work (laboratory work, drawing, woodwork, and metalwork). No attempt is made to specialise for any one particular industry. The practical work for girls consists of elementary science and housecraft. This type of school as a whole, though doing excellent work, suffers somewhat in the public estimation through it being regarded as inferior in prestige to the ordinary secondary school. The training given in the central schools is probably better fitted to the after circumstances of the majority of boys and girls from the elementary schools than is that afforded by the usual type of secondary schools.

(2) *Junior Technical Schools and Trade Schools.*—This class of schools suffers from a bewildering variety of names—junior technical schools, trades preparatory schools, pre-apprenticeship schools, and trades schools. Generally speaking, the junior technical schools provide a wider training in general education and in theoretical work than the trades schools. Again, junior technical schools are understood not to specialise for one particular trade, but to provide a training enabling a boy to enter any branch of a group of industries, such as engineering or the building trades. The trades schools specialise more severely than this in many cases. Actually, the names of the schools are often misleading, so-called "trades" schools being really "junior technical" schools. At the present time the general tendency is in favour of the "junior technical school," with its wider educational outlook and less severe specialisation, rather than the "trades" school proper.

There are about sixteen junior technical or trades schools in London, with about 800 boys and 3000 girls in attendance. In other portions of England and Wales there are about twenty such schools, with, say 1200 pupils, and in Ireland twelve schools with 500 pupils. Scotland relies upon a system of "supplementary classes," which in effect is very similar to the "central schools" described earlier.

The provincial schools are usually designed to provide only for the engineering, building, and metal trades. Manchester has recently established a Day Trade School of Dressmaking. London trade schools cover a wide field of more or less specialised instruction, *e.g.* furniture and woodworking trades, book production, silversmith's work, tailoring, bakery and confectionery, cookery (for *chefs*), and many women's trades. The net annual cost of the trade schools maintained by the London County Council is approximately 15*l.* to 21*l.* a student. There is no definite provision, except at Cardiff, for instruction in commercial subjects along junior technical-school lines.

The curricula of these schools vary considerably. Broadly speaking, each school allows about three to four hours a week for English, three to four hours a week for mathematics or arithmetic, and of the remaining time, about one-third is devoted to theoretical instruction in the theory or sciences, if any, allied to the special trade or industry, and about two-thirds to the practice of the trade or practical work (including drawing office, workshops, laboratory work, or drawing) connected with the industry. Considerable attention is given to continuing the general education of the pupils, with the result that but for the omission of a modern language, the boy of sixteen in the better type of junior technical school is educationally on a level with the average boy of the same age in the secondary school. The physical welfare of the children is helped through the agency of organised games and gymnastics. The pupils are encouraged to organise clubs and societies in order to foster the social life and corporate spirit of the schools.

On the whole this type of school has been very successful, especially perhaps the trade schools for girls in London. Close contact with the trades and industries is secured in many of the schools by the formation of "advisory committees," consisting of representatives of employers and of labour. The pupils are generally keen upon their work, and the tone of the schools is good. There is comparatively little difficulty in most cases in securing positions in industrial life for the boys or girls at the completion of their course. The work done in these schools generally enables the boy or girl to shorten the period of apprenticeship very considerably and to obtain higher wages than they would otherwise have secured.

The success of the relatively few junior technical schools or trades schools which have been established so far points to the probability of a rapid increase in the number of these schools in the immediate future. Broadly speaking, about half a million boys and girls leave the elementary school each year, less than one-tenth of these passing forward to the secondary school, and only about 2000 to the junior technical or trades schools. Of the remainder, a considerable proportion would probably amply repay further systematic full-time education, not of the customary literary type, but of a more practical character, such as is given in the junior technical or trade schools. One point, however, must be watched. The Board of Education, in the recent regulations for junior technical schools, states that these schools are not intended to furnish a preparation for higher "full-time" technical work, this being one of the functions of the secondary school. This would make the junior technical schools a "dead end" so far as further day technical work is concerned. In science and mathematics, the fundamental subjects in technical work, the boy in the junior technical school is ahead of the secondary-school boy. The junior technical school should be another avenue, alternative to the secondary school, by means of which the bright boy could pass from the elementary school to the technical college. This is especially important in the case of the boy who develops somewhat late or whose mental activities only become aroused by contact with things rather than with books.

J. Wilson.

THE INSTITUTION OF NAVAL ARCHITECTS.

The spring meeting of the Institution of Naval Architects opened on April 1 at the rooms of the Royal Society of Arts. The institution's gold medal was awarded to Mr. G. S. Baker, for his paper on methodical experiments on mercantile ship forms. Premiums were awarded to Messrs. A. Cannon and L. Woollard for papers dealing respectively with the effect of loose water on the rolling of a ship, and the effect of water chambers on the rolling of ships. In all fourteen papers were read and discussed during the three days over which the meeting extended.

In a paper dealing with some questions relating to battleship design, Mr. T. G. Owens states that the present tendency in warship construction and design, as exemplified in the later ships of all the principal maritime powers, is towards very large displacements, with the arrangement of all the guns of the primary armament on the centre line, and with the guns of the secondary armament placed in an armoured citadel on, or immediately below, the deck carrying the primary guns. In respect to the above-water armoured protection, there is the usual thick armoured belt, extending, say from 4 to 6 ft. below the water-line, to the height of the main deck, and carried along the length of the vessel for such distance as to protect the machinery and boiler compartments and the magazines. The ends of the ship and the citadel have armour of reduced thickness. In all modern battleships there are horizontal protective decks. Protection against attack from bombs, etc., dropped from aircraft is not yet in the region of practical politics. When the time arrives to arrange measures to meet such attack, they will probably take form in the method advocated by Sir Trevor Dawson, *i.e.* to increase the thickness, and give a greater curvature, or whale-back formation, to the armoured deck.

Mr. W. J. Luke contributed a paper on experiments upon wake and thrust deduction, supplementary to another paper which he presented to the institution in 1910. The present paper has particular reference to experiments with contrary-turning screws on a common axis, with tandem screws, and also of experiments with quadruple screws. It appears from the experiments that the first-mentioned type of screw has not a little to recommend it, and were the engineering difficulties connected with its application to marine propulsion overcome, it would be well worthy of consideration. Tandem screws have nothing to recommend them.

Mr. J. T. Milton read a paper on the present position of Diesel engines for marine purposes, and Prof. W. E. Dalby described some results of trials made on a small Diesel engine in which accurate indicator diagrams were obtained by means of a new form of optical indicator.

Mr. G. S. Baker gave an account of a number of model experiments made to determine the effect of shape of area curve on the resistance at any reasonable speed. This paper gives also a brief account of the work of the year at the William Froude tank. A large proportion of time has been spent on test work for various shipbuilding firms. The resistance of at least five large vessels has been reduced more than 10 per cent. by modifications to the form made at the tank, and several others have been improved in a less degree. The importance and value of these results can be seen from the fact that the saving in cost of coal per annum for a single one of the above five ships would be more than sufficient to support the experimental tank for the same period. The investigation of the resistance and tipping moments experienced by aero-hydroplane floats has been continued. Considerable improvement has been effected in the power required for their propulsion, the tipping moments due to the water forces are now known, and a float which is stable in character and of a low water resistance has been evolved. Ship models have been tested with four different kinds of surface, the paraffin wax being (*a*) bare, (*b*) freshly coated with shellac varnish, (*c*) the same, with blacklead rubbed into a coating of shellac when the latter was "tacky," and then allowed to harden, (*d*) coated with red lead paint. The spots from the four surfaces were indistinguishable, and show that, provided the surface is smooth and free from grit, the same result will be obtained.

Mr. H. Gray gave the results of experience with superheated steam, with special reference to economy and cost of upkeep, based on more than three years' working in engines of both triple- and quadruple-expansion types in the mercantile marine engaged in regular trade, voyage after voyage, to Australia *viâ* the Cape of Good Hope. The system adopted was the Schmidt. None of the steamers have been delayed either in port or on the voyage by reason of superheater defects, notwithstanding the fact that the runs are long—that of the *Port Augusta* being forty-five days without a call at any port. Lubrication of the cylinders and valve faces is of the utmost importance with superheated steam, and it is absolutely necessary to have a trustworthy system of filtration for the feed-water, so as to ensure the abstraction of the oil and to safeguard the boilers from the possibility of any traces of oil being introduced. The author states that the economy of triple-expansion engines of 2000 i.h.p. after being altered to use superheated steam, has been increased about 12 per cent., and of quadruple-expansion engines, about 17·8 per cent.

Mr. C. E. Stromeyer contributed a paper on the elasticity and endurance of steam pipes, and a note on the Foster strain meter, and some data obtained therewith were presented by Mr. W. R. Gerald Whiting.

Dr. K. Suyehiro, professor of naval architecture at Tokio Imperial University, described a new torsionmeter which he has devised. This instrument has some interesting features. The angle of twist of the shaft is measured by the relative rotation of two arms, one clamped to the shaft, and the other carried by a long tube clamped to the shaft at the end remote from the other arm. The first-mentioned arm carries a scale having half-millimetres along one edge and a reading scale along the other. The scale faces the shaft, and mounted on the same arm is a plane mirror, situated half-way between the shaft axis and the scale. Hence a virtual image of the scale will be seen every revolution, coinciding with the shaft axis, and therefore at rest. On the other arm is a concave mirror which forms an image of the reading edge of the scale, also on the shaft axis, and side by side with the first image. Both images are picked up by a reading telescope, and their relative displacement when the shaft is twisted may be read easily. The advantage of the instrument lies in the fact that the scale, as well as the optical parts, rotates with the shaft, and the reading telescope requires but little adjustment. Other types in which the scale does not rotate, require considerable adjustment in a place, viz., the shaft-tunnel, where adjustment is not easy to carry out.

Other papers read dealt with the stability of ships in damaged conditions, and the rolling of ships. Mr. H. E. Wimperis described his instrument for the measurement of velocity of roll, which depends for its action on a small electrically-driven gyrostat.

PAPERS ON INVERTEBRATES.

A REPORT on the Crustacea Schizopoda, collected by the Swedish Antarctic Expedition, 1901–3, has been published, in 4to form, by G. E. C. Gud, of Copenhagen. In his preface, the author, Mr. H. J. Hansen, states that this memoir, which is illustrated by six plates, should be regarded as a further contribution to his account of the Mysidacea and Euphausiacea (the two main groups of the Schizopoda) of the world. A considerable number of new species are named, and revised descriptions of others previously known to science given, but as these appeal only to specialists, they must be passed over without further mention.

Two Calyces of Scyphocrinus. From Proc. U.S. Nat. Mus.

Of more general interest is Mr. R. S. Bassler's description (Proc. U.S. Nat. Mus., vol xlvi., pp. 57–9) of a remarkably fine slab of fossil crinoids from the Middle Palæozoic strata of the Mississippi Valley, north of Cape Girardean, Missouri, which has recently been placed on exhibition in the American Museum. This slab, measuring 4 ft. by 7 ft., contains eighteen complete crowns of Scyphocrinus, two of which are shown in the accompanying illustration, together with a number of bulbs of the so-called Camarocrinus; the latter, as pointed out by Dr. Bather, really pertaining to the former. In some of the specimens the crown, or calyx, retains to some extent its original globular form, but in the majority it has been flattened by contact with the Camarocrinus bulbs. The strong, many-branched arms, are frequently a foot in length.

The first American representative of the umbrella-shaped sponges of the genus Cœloptychium is described by Messrs. Shimer and Powers in vol. xlvi., pp. 155–6, of the Proc. U.S. Nat. Mus., under the name of *C. jerseyense*. As the type specimen was obtained from the Upper Cretaceous of New Jersey, it is strictly contemporaneous, in the geological sense, with the European forms of the genus to which it is provisionally referred. The American species is characterised by the rounded, in place of flattened, margin of the umbel.

Hitherto the number of species of oligochætous annelids known from Jersey was only eleven, all belonging to the earthworm family (Lumbricidæ). A collection, including fresh-water forms, recently received from the island has, however, enabled the Rev. H. Friend, in an article published in *The Zoologist* for December, 1913, to raise the number of known species to fifty, of which three are described as new. Of the fifty species, the Enchytræidæ claim thirty-one, the Lumbricidæ seventeen, and the Lumbriculidæ and Megascolecidæ one each.

R. L.

METEOROLOGICAL REPORTS.

THE report of the Meteorological Service of Canada for the year 1909 (pp. xxi+567 and plates), has been published recently. The large mass of data furnished by this extensive system is arranged in tables giving (1) monthly and annual summaries; (2) bi-hourly and hourly temperature and barometric pressure; (3) mean and extreme temperature, daily range, rainfall, etc.; (4) daily observations from selected stations; and (5) magnetic results at Agincourt Observatory. Some of the results of observations at the Central Observatory at Toronto were quoted in Nature of September 7, 1911. The report includes a brief monthly summary of the weather over the whole Dominion, and tables showing the number of weather forecasts and percentage of fulfilment in each district and month. The general percentage of fulfilment amounted to 86·8, after making due allowance for forecasts only partly verified.

The annual reports of the Philippine Weather Bureau for 1910 (parts 1 and 2), containing hourly meteorological observations at Manila, and for 1909 (part 3), containing observations at secondary stations have recently been published. Father Algué states in the preface to part 1:—"Were it not for a few exceptions, the history of the Weather Bureau for the fiscal year 1910 might have been condensed into the three words, 'Everything as usual.'" This statement practically holds good with regard to all the parts; the most interesting details relating to typhoons, storm-warnings, earthquakes, etc., are contained in the Monthly Bulletins, to which we have frequently referred. The number of earthquakes felt in the Philippines during the fiscal year 1910 amounted to 121, exclusive of many microcosmic movements. The most important far-distant earthquakes recorded were those in Mexico, Baluchistan, and Greenland. A new magnetic observatory has been established at Antipolo, about eleven miles east of Manila, owing to the disturbance caused by the electric railroad at the latter place.

The Central Meteorological and Geophysical Institute of Chile has issued a volume containing hourly observations and means for Santiago for the year 1911, including all the principal meteorological elements, prepared under the direction of Dr. W. Knoche. This is the first time that such values have been published *in extenso* in Chile, and it is intended to continue them regularly for Santiago in future. There are several other stations in Chile, where hourly observations are available; the publication of some of these, or at least summaries from them, would be very valuable, but the large amount of work entailed thereby is said to be more than the limited staff is able at present to cope with.

The nineteenth annual report of "Meteorology in Mysore" for 1911 contains, as usual, daily and monthly results of observations for Bangalore and Mysore, and 8h. a.m. observations, with monthly means for Hassan and Chitaldrug. Synopses of the monthly and yearly results made at those observatories are carefully arranged as before, for the purpose of comparison, by Mr. Iyengar, in charge of the Mysore meteorological department. A useful table giving the means for the nineteen years 1893–1911 shows that the absolute maxima of temperature ranged from 100·2° at Hassan (3149 ft.) to 103·0° at Chitaldrug (2405 ft.). The minima at the same stations were 42·7° and 51·2° respectively. Yearly rainfall ranged from 25·0 in. (ninety-one days) at Chitaldrug, to 35·8 in. (121 days) at Hassan. The mean relative humidity was about 60 per cent. at all stations; excessively low readings were observed occasionally.

The Royal Magnetical and Meteorological Observatory of Batavia has published the results of rainfall observations in the Netherlands' East Indies for 1911 (part ii. of the thirty-third yearly series). The volume contains the monthly and yearly amounts at a large number of stations, the number of rain-days, greatest amounts in twenty-four hours, averages for the period 1879–1911, departures from those values in 1911, and other useful details. These data, in addition to their general scientific value, are of great importance locally, and it has been pointed out elsewhere by Dr. Van Bemmelen that rainfall is the ruling factor which determines the weather in the archipelago, because the remaining meteorological elements are almost constant. In Java the yearly amounts for 1911 varied from 23 in. at Sitoebondo (long. 114° E.) to 177 in. at Pelantoengan (long. 110° E.), and even more in the outside possessions. The greatest rainfall in one day was 10·2 in. at Padang (Sumatra) in November. The fullest information is given respecting the stations, but this volume contains no general discussion of the results.

IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.

THE subject of improvements in telephony is one in which the general public is very closely interested, and a large audience, including many experts, therefore followed with attention the expositions given by Dr. J. A. Fleming, F.R.S., at the Royal Institution on March 27, in which he described the inventions that of late years have enabled a great increase in the practicable distance of telephonic communication to be made, and also rendered possible the use of submarine telephone cables over distances not hitherto attainable. In his opening remarks, Dr. Fleming gave first a brief description of the construction of the modern telephone transmitter and receiver, and of the transformations and sources of loss of energy in transmitting electrically articulate speech between two places. He stated that he would confine attention chiefly to the action of the line of cable, neglecting the imperfections of the transmitter and receiver *per se* owing to limitations of time.

An experiment was first shown with an instrument which projected upon the screen in the form of a line of light, the motion of the diaphragm of a telephone, when sounds musical or articulate where made near it The sound of an open organ pipe was thus seen to produce a smooth wavy or simple harmonic curve, whilst the less pure sound of a harmonium reed or of the voice uttering a vowel sound produced a complex curve, and a spoken sentence an irregular wave line.

The use of the oscillograph in recording photographically or visually the wave form of the electric current sent into a telephone was next explained, and photographs of various vowel and syllabic sounds shown.

A few words of explanation were then given concerning Fourier's theorem in virtue of which any irregular but single valued curve can be resolved into the sum of a number of simple harmonic curves of various amplitudes and phase differences having frequencies in the ratio of 1, 2, 3, etc.

It was then explained that the action of the transmitter on the line was equivalent to the imposition of a complex electromotive force which in virtue of Fourier's theorem could be regarded as the sum of a large number of simple harmonic electromotive forces of various amplitudes, wave-lengths, and phase differences.

Every telephonic cable has four primary qualities, two conservative, viz., its inductance and capacity, in consequence of which it can store up kinetic and potential energy in the form of a magnetic or electrostatic field. Also it has two dissipative qualities, viz., its conductor resistance and dielectric leakance, which convert a part of the energy given to it into heat. Hence an electromotive impulse given to the cable at one end is propagated along it as a wave. The current in the cable at each point is oscillatory, but the current is not, so to speak, at high tide simultaneously at all points in the cable, but successively, the maximum value travelling along the cable with a certain speed. The mode of propagation of a wave along a string or wire was illustrated by various wave models.

In the case of a wire or string of finite length the wave is reflected at the far end, and if the time taken by the wave to travel to and fro is equal to some exact multiple of the periodic time of the impulses, stationary waves are produced on the cord or wire. These effects, together with a demonstration of the laws of string vibration, were proved by the aid of Dr. Fleming's vibrating string apparatus in which a light cotton cord has one end fixed to a slide rest and the other end twirled uniformly with an irrotational motion by an electric motor.

The production of stationary electric waves on wires was also beautifully shown by the use of a long wire coiled into a helix on an ebonite rod. One end of this helix was connected to the earth and the other to a high-frequency oscillator. On adjusting the frequency of the oscillator, stationary electric waves of wave-length equal to some exact multiple or fraction of the length of the helix were produced and shown to exist by the brilliant glow of a neon vacuum tube held near the ventral segments and its non-glow when held near the nodes.

Dr. Fleming then explained that in the case of a telephone wire the velocity with which the waves travel along it is greater the shorter the wave-length, and also that in virtue of the resistance and dielectric leakance, these waves attenuate in amplitude at a rate which is greater for short waves than for long ones. In the case of the helix operated on by high-frequency currents the wave velocity is the same for waves of all wave-lengths, and is inversely as the square root of the product of the capacity and inductance per unit of length. Hence when a complex electromotive force, the result of speaking to a telephone transmitter, is applied to the end of a cable the various simple harmonic waves into which they may be resolved travel along the cable with unequal speed and attenuation. The shorter waves travel fastest, but are worn out soonest. Hence the wave form is distorted by the disappearance of the higher harmonics and the resulting sound is enfeebled by the attenuation.

Dr. Fleming proved these statements by a new and interesting experiment. A complex electromotive force comprising a fundamental wave having a frequency of about one hundred, and including higher harmonics of greater frequency was applied to one end of an artificial cable built on Dr. Muirhead's plan, representing a submarine cable fifty miles in length. By means of a Duddell oscillograph the wave form of this electric oscillation was projected on the screen. A second wire on the oscillograph was then employed to examine the current in the cable at various distances, ten, twenty, thirty, etc., miles from the sending end, and to project on the screen a second curve representing the wave-form at various distances along the cable. It was seen that as the distance increases the wave form is reduced in height and smoothed out so as to show that the higher harmonics are gradually extinguished. In the case of a telephone cable this would mean that the received sound is not only fainter but altered in quality so that the syllable or word is no longer recognisable.

Photographs were then shown, taken by Mr. Cohen at the General Post Office Research Laboratory, showing the distortion of various articulate sounds as transmitted through certain cables. A remedy for this distortion was first suggested by Mr. Oliver Heaviside, who proved mathematically more than twenty-five years ago that if the four constants of the cable were so related that the quotient of the inductance by the resistance was equal to the quotient of the capacity by the leakance, then waves of all wave-lengths would travel at the same speed and attenuate at the same rate.

In all ordinary cables the first-named quotient is much smaller than the second. Hence to remove distortion we may either increase inductance or leakance. Heaviside suggested increasing the former, and Prof. Silvanus Thompson in 1891 suggested increasing the latter by providing the cable with inductive leaks. Practical telephone engineers preferred, however, to decrease the resistance of the cable by increasing the copper section so far as possible. There is, however, a limit to this from the point of view of cost. Also the invention of paper-insulated cables for telephony assisted matters by reducing the capacity of the cable. Nevertheless a very important advance was made by Prof. Pupin, of Columbia College, New York, in 1899 and 1900, when he proved that Heaviside's suggestion could be put into practical form by loading the cable with coils of wire wound on iron wire cores inserted at equal intervals, but so close that at least eight or nine coils are included in the distance of one wave-length of the average wave frequency which is always taken at 800. If the coils are placed farther apart relatively to the wave-length they do more harm than good. Dr. Fleming illustrated this by a very pretty experiment of his own consisting of a string loaded at intervals with beads, one end of the string being fixed and the other twirled round by a motor so as to produce on it stationary waves. When the half wave-length was adjusted to be nearly equal to the distance between the beads, the cord refused to transmit the oscillations.

It was also illustrated by the production of stationary electric waves on a series of helices of wire having loading coils, or coils of high inductance introduced at intervals.

An experiment was also shown with an artificial cable representing forty miles of standard cable into sections of which loading coils could be introduced or cut out as required. It was shown that when the cable was loaded the current flowing out of it at the receiving end was greatly increased when constant electromotive force was applied at the sending end.

It is found then that loading telephone wires by suitable coils of high inductance placed at proper intervals of a mile up to ten or twelve miles according to the cable, greatly reduces the attenuation of the waves, although it is difficult to add sufficient inductance to cure distortion completely.

Dr. Fleming gave a mechanical illustration of this effect. He said, suppose two similar ships were to be launched together side by side down ways of equal inclination and allowed to glide out into the sea as far as they would go until brought to rest by friction of the water. If then one of the ships was loaded with ballast so as to make it much heavier than the other, then, although entering the water with the same speed, the heavily loaded ship would glide out further than the other because it would possess a greater store of kinetic energy. So it is, he explained, with the electric waves on wire. By adding inductance to the circuit the wave energy is increased, and the waves attentuate less for a given distance of travel.

This proposal of Pupin has proved to be a very practical solution of the problem of reducing the attenuation of telephonic waves. Both aerial lines, underground cables, and submarine cables can be "loaded" or "Pupinised" by inserting appropriately made inductance coils at equal distances, and the result is to reduce the attenuation to half or less than a half of that of the unloaded cable, and therefore to reduce the enfeeblement of the sound.

In the case of aerial lines there is no difficulty in inserting these loading coils in the run of the cable. The coils are contained in iron boxes attached to the telegraph posts at intervals of six to twelve miles. The coils themselves consist of an iron wire core wound over with wire, and have generally an inductance of about 0·2 henry, and a resistance of 6 or 8 ohms. In the case of underground cables the loading coils are placed in pits at intervals of two or three miles. Such underground cables consist now of paper-insulated double metallic circuits; a large number of such circuits being included in one water-tight lead sheath. The problem of loading a submarine cable was more difficult to solve because the insertion of heavy iron-cased coils was out of the question. The cable had to be loaded in such manner as not to thicken it up inordinately at any point, and to permit of its being laid in the usual manner and lifted again if necessary for repairs. This particular problem was solved by Messrs. Siemens Bros. by the invention of a particular form of cylindrical loading coil which could be inserted in the run of a cable of the usual double-circuit type at distances of one nautical mile or so. When once it had been shown that such loading was effectual, telephonic engineers in all countries began to adopt it. In the United States the American Telephone and Telegraph Company has equipped with loading-coils lines up to 2000 miles in length. The longest aerial loaded line is that from New York to Denver. It is composed of No. 8 hard-drawn copper wires, the circuits being twisted to avoid cross talk and loaded every eight miles with coils having an inductance of 0·265 henry (see Table I.).

The attenuation constant of the line is thus reduced to less than half of that of the unloaded line, and good speech is possible from New York to Denver. It is the ambition of Mr. Vail, the president, and Mr. Carty, the able engineer of the above company, to complete a loaded line such that speech will be possible from New York to San Francisco, a distance of more than 3000 miles. Another long loaded aerial line just completed is that from Berlin to Rome. This line, with the exception of a short piece of cable through the Simplon Tunnel, is an overhead line of phosphor-bronze, 4·5 mm. in diameter. It is loaded every ten kilometres with loading coils having an inductance of 0·2 henry. It runs from Rome to Milan, thence to Iselle, then through the Simplon Tunnel to Brieg, then to Bâle and Frankfurt, and so to Berlin.

TABLE I.

Loaded Aerial Land Lines.

All values are per mile or per kilometre at 800 frequency.

Line	New York and Denver	Berlin and Rome	Berlin and Frankfurt	London (St. Albans) and Leeds Trunks No. 6	London (St. Albans) and Leeds Trunks No. 7
Length ...	2000 miles	2082 kms.	584 kms.	189 miles	189 miles
Coil Spacing...	8 miles	10 kms.	5 kms.	8 miles	12 miles
Coil Resistance	6 5 ohms.	5	8·7	6·6	4·0
Total Resistance	4·95 ohms.	2·9	11·18	7·58	7·08
Capacity in mfds.	0·0091	0·0056	0·0055	0·0098	0·0098
Inductance in henrys ...	0·0365	0.022	0·0461	0·037	0·0173
Attenuation Constant ..	0·0013	0·0011	0·0019	0·00283	0·00372
Total Attenuation	2·6	2·2	1·12	0·55	0·72
Conductor ...	Copper	Phosphor Bronze	Bronze	Copper	
Weight or Size	435 lb. to mile	4·5 mm. diameter	2·5 mm. diameter	300 lb. to mile	

Dr. Bresig and Dr. di Pirro, who have had the charge of the scientific work in connection with it, find the actual attenuation is closely in accordance with the predicted value, and good speech is possible over the whole distance.

In our own country the longest loaded lines are two trunk lines running from London to Leeds, 200 miles, which are loaded every eight and twelve miles.

The engineer-in-chief, Mr. Slingo, states that the General Post Office has now in operation 30,000 miles of aerial and underground loaded circuits, using 12,448 loading coils; also 45,645 miles more are in course of being loaded, so that before long the G.P.O. will have 75,000 miles of circuits loaded with 30,000 coils. In the United States up to 1912 there were 103,000 miles of loaded circuits in all.

In England one of the longest loaded underground lines is that from Hull to Newcastle *viâ* Leeds, 154 miles in length, which is loaded every 2·5 miles. The Post Office has now under construction an underground loaded line from London to Liverpool *viâ* Birmingham, which will contain fifty circuits, and render communication independent of storms. In the United States a long underground line has been constructed from Boston to Washington, 475 miles, passing through New York, Philadelphia, and Baltimore. A loaded line underground from Berlin to Cologne is in contemplation.

Turning then to submarine cables, we find that at present the General Post Office has three such loaded cables, one from England to France, laid in 1910, one from England to Belgium, laid in 1911, and one from England to Ireland, laid in 1913 (see Table II.). An Anglo-Dutch cable of the same type is being manufactured to be laid between a point in Suffolk and the nearest point on the coast of Holland, a distance of 125 miles.

TABLE II.

Loaded Submarine Telephone Cables.

All values are per nautical mile of loop at 800 frequency.

Cable	Anglo-French Coil loaded 1910	Anglo-Belgian Coil loaded (1911) Side Circuit	Anglo-Belgian Phantom Circuit	Anglo-Irish Coil loaded (1913)
Length in nauts	21	48	48	64
Coil Spacing in nauts	1	1	1	1
Coil Resistance in ohms. ...	6·6	11·5	4·6	6·8
Total Resistance in ohms. ...	20·9	25·7	11·7	21·0
Capacity in mfds.	0·138	0·162	0·314	0·166
Inductance in henrys	0·1	0·1	0·05	0·1
Ratio S/C	120	12	12	12
Attenuation Constant	0·017	0·018	0·0173	0·015
Total Attenuation	0·36	0·86	0·83	0·96
Conductor weight per naut ...	160 lb.	160 b	320 lb.	160 lb.

The Anglo-French uniformly loaded cable has an effective resistance of 8·54 ohms at 1000 frequency, a wire-to-wire capacity of 0·176 mfd., an inductance of 0·0135 henry, and an attenuation constant 0·0185. The total attenuation is 0·39,, the value of S/C is 109, and the conductor weighs 300 lb. to the nautical mile.

These cables were all constructed by Messrs. Siemens Brothers with the cylindrical coils above-mentioned. The Anglo-French and Anglo-Belgian were laid under the direction of Major W. A. J. O'Meara, C.M.G., when engineer-in-chief of the General Post Office, and the Anglo-Irish cable under Mr. W. Slingo, now holding the same position. The French Government also laid from France to England a uniformly loaded cable made by the Telegraph Construction and Maintenance Company, which has a copper core of twice the weight of the Anglo-French cable, and is loaded by being uniformly wound over with one layer of soft iron wire. Each of these cables contains two pairs of wires which can be used as two independent circuits, and also by using each pair conjointly, as a lead and return, can be used to make a third or phantom circuit. These cross-Channel loaded cables have enabled telephonic speech to be transmitted from London to Geneva, London to Berlin, and to cities in the south of France.

Broadly speaking, we can say that by loading cables and lines it has been possible to double or more than double the distance of effective telephonic intercourse, and to speak for 2000 miles overland, 500 underground, and up to 100 miles or more under sea.

It is possible that submarine communication in this manner may be increased to 150 or even 200 miles, and overland to 3000 miles.

Turning then to the question of the abolition of the line by so-called wireless telephony, Dr. Fleming gave a brief description of the apparatus used. The arrangements are closely similar to those employed in wireless telegraphy. At the transmitting station there must be an antenna in which continuous oscillations are set up by a Marconi disc generator, a Goldschmidt alternator, or some form of arc generator, such as that of Poulsen or Moretti.

In the base of the antenna, or coupled to it, must be placed a microphone by means of which the speaker's voice makes changes in resistance of the antenna circuit. The continuous electric waves radiated must have a wave-length of not much greater than five or at most ten miles. If a spark system of wave generation is employed, the spark frequency must not be less than about 20,000 a second.

When the microphone is spoken to, the result is to vary the amplitude of the waves emitted without altering their wave-length. It produces waves on waves. At the receiving end the arrangements are similar to those used in wireless telegraphy with a telephonic and crystal or valve receiver. In this case, however, the receiver hears the words spoken to the distant microphone and not merely dot and dash Morse signals.

Using a very ingenious liquid microphone, Prof. Vanni, of Rome, has transmitted speech for 1000 kilometres. In the United States, Fessenden has similarly telephoned a few hundred miles, and Poulsen in Denmark, Colin and Jeance in France, Goldschmidt in Germany, and Ditcham in England have covered greater or less distances. Mr. Marconi also has recently devised appliances for wireless telephony with which he has conducted demonstrations for the Italian Navy lately. All are agreed that the quality of the transmitted speech is good. Since electric waves through the æther all travel with the same velocity, no matter what the wave-length, and attenuate at the same rate, there is no distortion of the wave form. The only difficulty that hinders even greater achievement is that of obtaining a microphone which will carry larger high-frequency currents.

These then are a few of the achievements which have been lately made in covering greater distances in telephonic communication.

We are yet a long way from telephony across the Atlantic, whether with cables or by wireless, but progress will continue to be made, and it is possible that one day speech transmission from England to San Francisco with one repetition at New York may be an accomplished fact.

In the thirty-eight years which have elapsed since Bell and Edison and Hughes gave us the means of commercial telephony much has been done, but there is still a wide field open for invention in improving a means of communication now so essential to our modern life.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Sheffield.—Mr. Wilfred Jevons has been appointed to the post of junior lecturer and demonstrator in physics, and Mr. A. E. Barnes to the post of lecturer in materia medica, pharmacology, and therapeutics.

Prof. Bergson will begin his Gifford Lectures in Edinburgh on Tuesday, April 21. The subject will be "The Human Personality."

It is announced that Lord Elgin has consented to be nominated for the Chancellorship of Aberdeen University in succession to the late Lord Strathcona.

We learn from *Science* that Prof. Frederick Slocum, who for the past four years has been in charge of the solar observations and stellar parallax work at the Yerkes Observatory, has been elected professor of astronomy at Wesleyan University, Middletown, Connecticut, and will assume his new duties next autumn. A new observatory will be erected immediately as a memorial to the late Prof. Van Vleck, for many years in charge of that department at Wesleyan.

Museums are every day being used more generally in teaching, and a committee to deal with the subject was appointed at the Birmingham meeting of the British Association. The Children's Museum arranged by the secretary of the Selborne Society at the Children's Welfare Exhibition, which opens at Olympia on Saturday, is therefore of interest. The points to be emphasised are, preparation of exhibits especially for young people, introduction of a living side, the use of microscopes, the need especially of changing the specimens at frequent intervals, and the advisability of not having too many things displayed at one time.

The work of the schoolmaster is described in a new light by Mr. E. Boyd Barrett in an article in the current issue of the *British Review*. Early in his essay, to which he gives the title, "How to Complete One's Education," Mr. Barrett lays it down that teaching is worthy of the best minds, and is calculated to repay amply the best minds. He goes on to show that in all the practical effects of school education—character training, intellect training, and the acquisition of knowledge—the schoolmaster benefits more from the teaching he receives from the boys than they do from his. He comes to the conclusion that it would be impossible to devise any educational system of such a nature that the pupil alone would be benefited. To complete his education, every man should devote a few years to teaching; university education, however well it prepares for cultured leisure, does not prepare a man to share his possessions with others—it is too egotistic.

The Yorkshire Summer School of Geography will be held at Whitby on August 3–22. The school was instituted last year by the Universities of Leeds and Sheffield, in cooperation with Armstrong College, Newcastle-on-Tyne, and with the help of the Education Committees of the County Councils of the East, North, and West Ridings, and of certain county boroughs in Yorkshire. Its object is to provide instruction in the methods of geography and to furnish opportunities for the discussion of problems connected with teaching it. The course will consist of lectures and laboratory and field work. There will be excursions in connection with the field work. All the apparatus used will be simple and inexpensive, and methods applicable to school work will be adopted. The special subject this year will be the British Isles, which will be treated as a whole in a general course and in two alternative courses at the choice of each candidate: (i) on the agriculture, rocks and soils, and (ii) on the oceanography, rivers and river development, and the evolution of transport and communication. Prof. Kendall, professor of geology in the University of Leeds, will be the director of the school.

The annual report of the Department of Agriculture of the Union of South Africa for the period 1912–13 has just been issued by the secretary, Mr. F. B. Smith, and is a very interesting document. Necessary as agricultural education and research have proved in other countries, there is probably no part of the world where they are more needed than in South Africa. Agricultural problems are very complex; probably more numerous and virulent diseases of live stock and crops exist there than anywhere else in the world; and, owing to the recent occupation of the greater part of the country and the methods of farming pursued, it is more difficult for young men to acquire a knowledge of up-to-date practical agriculture. A number of institutions have been started, and the object of the department has been to place them on an equality as regards educational and experimental facilities, and at the same time to allow them to specialise in the branches of farming for which they are particularly adapted by virtue of their situation. For instance, Elsenburg, in the Cape Province, is particularly devoted to horticulture, viticulture, and Turkish tobacco; Grootfontein, near Middelburg, also in the Cape Province, to Karoo farming, ostriches, and sheep; Potchefstroom, in the Transvaal, to mealie growing, general agriculture, and cattle; Glen, near Bloomfontein, in the Orange Free State, to live stock and dry-land farming; Cedara, in Natal, to general farming and wattle growing. Provision is made at each institution for the regular in-college courses of instruction, for short courses, extension work, and also for experiments and research and the analysis of soils, manures, and other agricultural commodities. Additional buildings are being erected to meet the needs of the institutions, and their equipment generally is being improved, while the staffs are being strengthened.

SOCIETIES AND ACADEMIES.

Geological Society, March 25.—Dr. A. Smith Woodward, president, in the chair.—Prof. J. W. **Judd**: The geology of Rockall. Rockall is a small isolated rock in mid-Atlantic, lying 184 miles west of St. Kilda, and, except in the calmest weather, is inaccessible. The rock rises from a bank (the "Rockall Bank") upon which there are dangerous reefs. In 1810 Basil Hall, obtained a fragment from this rock, which later found its way into the collection of the Geological Society. More than thirty years afterwards, the specimen was recognised; it was then mislaid for another thirty years, and in 1895 was brought to the author by the late Prof. T. Rupert Jones. He not only studied all the literature connected with Rockall, but was able to trace two other specimens of the rock, the loan of which he obtained and brought to me. They had been procured in 1868 during the survey of the North Atlantic. The microscopic study of these specimens shows that in Rockall there exist rocks of interest, not represented in our islands, but which have analogues in the Christiania district of Norway. These rocks consist essentially of three minerals—quartz, the felspar albite, and the rare soda-pyroxene ægirite, with its dimorphous form acmite. Dredging operations have yielded specimens from the Rockall Bank. The abundance of basalt-fragments among the dredgings suggests the possibility of Rockall belonging to the same petrographical province as St. Kilda, Iceland, the Inner Hebrides, and the north of Ireland. The existence of borolanite and other alkaline rocks in the northern Highlands suggests the possibility of Rockall being the western extension of a much older province. Some months ago Prof. Iddings and Dr. Washington represented to the author the desirability of a detailed analysis of this rock. One of the two fragments available was sent to America, and the following paper gives the result of its study by Dr. Washington.—Dr. Henry S. **Washington**: The composition of Rockallite. A petrographical account is given, with reference to the influence of the constituent minerals upon the bulk-analysis. Rockallite has a fine-grained granitic structure, and is composed of about equal amounts of colourless quartz, alkaline felspar, and soda-pyroxene. The pyroxene is of two kinds: a bright grass-green ægirite and a pale yellowish-brown acmite. Some zircon is present. A chemical analysis has been made, zirconia and the rare earths being especially looked for. Several new points of interest have presented themselves. The outstanding features appear to be the high percentages of silica, ferric oxide, and soda, and the low percentages of alumina, ferrous oxide, magnesia, lime, and potash. The interest of the new analysis, however, lies in the detection of zirconia and cerium oxide in large amounts: the percentage of cerium oxide being larger than that from any known igneous rock, with the exception of the nepheline-syenite from Almunge in Sweden. The norm has been calculated from the old and the new analyses, and the author finds that the rock falls into the subrang rockallose with the general symbol III. 3. 1. 5. These analyses are the only representatives of the subrang rockallose among the 8000 analyses of igneous rocks that the author has now collected. It is proved that the zirconia and cerium oxide enter into the composition of the pyroxenes.

Cambridge.

Philosophical Society, February 23.—Sir J. J. Thomson in the chair.—Dr. **Searle**: (1) Determination of the effective aperture of the stop of a photographic lens; (2) experiments with a prism of small angle.—A. E. **Oxley**: (1) The molecular field in diamagnetic substances (preliminary note); (2) the internal molecular field, which has been shown by the author to exist in diamagnetic substances, is applied to account for the abnormally high values of the specific heat of such substances in the neighbourhood of the fusion point.—Major P. A. **Macmahon**: The superior and inferior indices of permutations.—N. **Wiener**: A simplification of the logic of relations.—R. **Hargreaves**: The domains of steady motion for a liquid ellipsoid, and the oscillations of the Jacobian figure.—J. E. **Purvis** and E. H. **Black**: The oxygen content of the river Cam before and after receiving the Cambridge sewage effluent.

March 9.—Dr. Shipley, president, in the chair.—Prof. **Wood** and G. Udny **Yule**: A statistical study of feeding trials with oxen and sheep. The authors have studied statistically the results of 400 feeding trials with oxen and sheep collected and tabulated by Ingle in the Journal of the Highland and Agricultural Society, 1909–10. They find that as the amount of food is increased above that required for maintenance the successive increases in live weight become smaller until a limiting value is reached.—G. Udny **Yule**: Fluctuations of sampling in Mendelian ratios. The author compares the fluctuations observed, *e.g.* in the proportion of recessives in F_2, in the seeds borne by individual plants, or in individual litters, with the fluctuations to be expected on the theory of random sampling. For the most part the agreement, in the examples taken, is good and in some cases striking.—M. S. **Pease**: Inheritance in Brassicæ.—G. Udny **Yule** and F. L. **Engledow**: The determination of the best value of the coupling ratio from a given set of data.—F. L. **Engledow**: A case of repulsion in wheat. The characters concerned are "roughness" and "blackness" of the chaff. In a cross between "smooth black" and "rough white" the numbers in the second generation indicate a repulsion on the 1 : 3 : 3 : 1 basis.—T. **Rigg**: Soil and crop relations in the Biggleswade market garden area. The author has conducted a soil and crop survey of this district. The soils have been classified and the extent of each soil formation has been determined. Maps were shown illustrating the relationship of the soil formations to the geological formations.—H. A. D. **Neville**: Digestibility of pentosans. Rats were fed on a basal diet, to which was afterwards added a quantity of some pentosan substance, such as (*a*) gum, (*b*) a vegetable mucilage, or (*c*) the pentosan constituent of a cereal straw. The pentosans of (*c*) almost entirely disappeared in the animal, those of (*b*) were almost wholly rejected, while those of (*a*) occupied an intermediate position. The results support the idea that the diverse opinions held on the food value of the pentosans have arisen by reason of the analytical method used yielding furfuraldehyde from differently constituted substances or from substances containing pentose sugar molecules differently united in the parent substance.—W. H. **Parker**: A case of correlation in wheat. A high correlation was found to exist between the total rachis length and the average internode length in ears of wheat. Should the correlation be found to be as high in the case of all varieties of wheat, it seems possible that the relation between these two characters will be found to be the best criterion for classifying wheats according to the density of their ears, as this relation, in this case at least, is much more constant within a variety, than the average internode length.—H. C. **Pocklington**: The factorisation of large numbers.—Dr. **Horton**: The ionisation produced by certain substances when heated on a Nernst filament. Experiments have been made to test (*a*) the negative emission from lime, (*b*) the positive emission from sodium phosphate, when heated upon a Nernst filament, with a view to ascertain whether the effects observed when these substances are heated upon platinum are due, as has been suggested, to contact with the metal. It has been found that this is not the case; an enormous negative discharge can be obtained from lime heated on a Nernst filament, even in a very high vacuum, and sodium phosphate considerably increases the positive discharge, but for the latter test the filament must not be allowed to glow brightly or the salt sublimes away.

Paris.

Academy of Sciences, March 30.—M. P. Appell in the chair.—G. **Lippmann**: A direct photographic method for the determination of differences of longitude. Photographs of the zenith are taken simultaneously at two stations by means of an optical device, and the difference of longitude determined by the position of the zeniths in the star groups. The method is simple, rapid, and accurate.—Armand **Gautier**: The minervites. Analyses of minervites (complex hydrated aluminium phosphates) from different places and a discussion of their constitution.—H. **Parenty**: The freezing of wine, milk, and other alimentary liquids.—Emile **Yung** was elected a correspondant for the section of anatomy and zoology in the place of E. Metchnikoff, elected foreign associate.—J. **Clairin**: Some Bäcklund transformations.—Jules **Drach**: Differential equations of the first order and first degree.—George **Rémoundos**: The series of multiform functions in a domain.—A. **Korn**: The problem of pulsating spheres and the theory of gravitation.—Edouard **Canneval**: A new arrangement of mirrors for lighthouses and other light projectors.—P. **Vaillant**: Tate's law and the variation of the size of the drops with the speed of fall. The weight of a drop from a given tube varies with the number of drops a minute, and there is a discontinuity in the law of variation.—L. **Décombe**: The heat of Joule considered as the heat of Siemens.—Albert **Perrier** and H. Kamerlingh **Onnes**: The magnetisation of liquid mixtures of oxygen and nitrogen and the influence of the mutual distances of the molecules of paramagnetism. The coefficient of specific magnetisation of liquid oxygen increases as the concentration diminishes; the additive law fails for mixtures of liquid oxygen and nitrogen.—Maurice de **Broglie** and F. A. **Lindemann**: A new method for rapidly obtaining spectra of the Röntgen rays.—V. **Auger**: The basic carbonates of copper.—E. **Rengade** and N. **Costeanu**: The heats of formation and some other properties of the alkaline sulphides. The sulphides of the alkali metals can be obtained in the pure state by the action of sulphur vapour upon the metals in a vacuum, separating the excess of metal by distillation. The sulphides of sodium, potassium, and rubidium have been studied in the present paper.—Mlle. H. **Cavaignac**: The precipitation of alumina in presence of fluorides. Aluminium cannot be completely separated from its solutions by the addition of ammonia in the presence of fluorides, and this is very marked at the boiling point.—MM. **Cousin** and **Volmar**: The salicylic nitriles. Of two substances which have been described as nitriles of salicylic acid, one is shown to be disalicylamide and the other trioxytriphenyltriazine. The true nitrile is obtained from salicylaldoxime.—Michel **Longchambon**: The primitive structure of the Pyrenean dolomites.—Edmond **Rosé**: Study of the gaseous exchanges and the variation in the sugars and glucosides in the course of the formation of the anthocyanic pigments in the flowers of *Coboea scandens*. The anthocyanic pigment is not formed at the expense of pre-existing glucosides.—Raoul **Bayeux** and Paul **Chevallier**: Comparative estimations of oxygen and carbon dioxide in arterial and venous blood at Paris, Chamonix, and on Mont Blanc. High altitude determines a variation in the amounts of oxygen and carbon dioxide in the blood, the increase in the carbon dioxide being greater than with the oxygen. Mountain sickness does not appear to cause notable modifications in the amount of carbon dioxide, but this state is accompanied by a marked diminution in the oxygen of the venous blood.—J. **Bergonié**: The variation in the energy expenditure of man during the nycthemeral cycle.—Edm. **Sergent**, H. **Foley**, and Ch. **Vialatte**: The transmission to man and to the ape of exanthematic typhus.—Marcel **Belin**: The action of oxidising substances upon toxins *in vivo*.—Adrien **Lucet**: Researches on the evolution of *Hypoderma bovis*, and the means of destroying it. The injection of tincture of iodine is suggested as a treatment. The larvæ are killed and resorption effected without ill-effects on the animal.—E. **Solland**: Researches on the ontogeny of the Caridea. Relation between the mass of the nutritive vitellus of the egg and the order of appearance of the abdominal appendages.—M. **Warcollier**: Contribution to the study of a disease of cider called "verdissement."—A. **Fernbach** and M. **Schoen**: Some products of the decomposition of dextrose in an alkaline medium. Acetic acid is one product of this decomposition, and there is evidence that pyruvic aldehyde is also formed.—Ch. **Dhéré** and A. **Burdel**: The crystallisation of an oxyhæmocyanine from an arthropod.

BOOKS RECEIVED.

The Cambridge British Flora. By Dr. C. E. Moss, assisted by specialists in certain genera. Vol ii. Text. Pp. xx+206. Vol. ii. Plates. Pp. vii+206. (Cambridge University Press.) 2*l*. 10*s*. net.

Neue Grundlagen der Logik, Arithmetik und Mengenlehre. By J. König. Pp. viii+259. (Leipzig: Veit and Co.) 8 marks.

Die Individualität der Zelle. By S. von Schumacher. Pp. 12. (Jena: G. Fischer.) 60 pfennigs.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 96. Jahresversammlung vom 7–10 September, 1913, in Frauenfeld. I. Tiel. Pp. 213. II. Teil. Pp. 249. (Aarau: H. R. Sauerländer und Cie.)

The Flora of the Dutch West Indian Islands. Second volume, The Flora of Curaçao, Aruba, and Bonaire. By Dr. I. Boldingh. Pp. xiv+197+plates. (Leyden: E. J. Brill.) 7*s*. 6*d*.

Bijdragen tot de Dierkunde Uitgegeven door Het Koninklijk Zoölogisch Genootschap Natura Artis Magistra te Amsterdam. 19e. Aflevering. Pp. 235+iv plates. (Leyden: E. J. Brill.) 13.50 marks.

Journal of the Royal Agricultural Society of England. Vol. lxxiv. Pp. 448+clvi. (London: J. Murray.) 10*s*.

Handbuch der naturgeschichtlichen Technik für Lehrer und Studierende der Naturwissenschaften. Edited by Prof. B. Schmid. Pp. viii+555. (Leipzig und Berlin: B. G. Teubner.) 15 marks.

The Eastern Libyans. By O. Bates. Pp. xxii+298+xi plates. (London: Macmillan and Co., Ltd.) 42*s.* net.

The Viscosity of Liquids. By Dr. A. E. Dunstan and F. B. Thole. Pp. vii+91. (London: Longmans and Co.) 3*s.* net.

Anales del Museo Nacional de Historia Natural de Buenos Aires. Tomo xxv. Pp. 249+xx plates. (Buenos Aires.)

Dr. Montessori's Own Handbook. By M. Montessori. Pp. viii+136. London: W. Heinemann.) 3*s.* 6*d.* net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xiii. (London: W. Wesley and Son.) 3*s.* 3*d.* net.

The "Conway" Manual, being a Complete Summary of all Problems in Navigation and Nautical Astronomy, etc. By J. Morgan, T. P. Marchant, and A. L. Wood. Pp. 79. (London: J. D. Potter.) 5*s.*

Animal Life by the Sea-shore. By Drs. G. A. and C. L. Boulenger. Pp. xii+83+plates. (London: "Country Life," Ltd.) 5*s.* net.

An Introduction to the Study of Integral Equations. By Prof. M. Bôcher. Second edition. Pp. 72. (Cambridge University Press.) 2*s.* 6*d.* net.

Anæsthetics: Their Uses and Administration. By Dr. D. W. Buxton. Fifth edition. Pp. xiv+477+viii plates. (London: H. K. Lewis.) 10*s.* 6*d.* net.

The School and College Atlas. (London: G. W. Bacon and Co., Ltd.) 3*s.* 6*d.* net.

Animal Flight. By Dr. E. H. Hankin. Pp. viii+405+index. (London: Iliffe and Sons, Ltd.) 12*s.* 6*d.* net.

Practical Instructions in the Search for, and the Determination of, the Useful Minerals, including the Rare Ores. By A. McLeod. Pp. ix+114. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s.* 6*d.* net.

Clean Water and How to Get It. By A. Hazen. Second edition. Pp. xii+196. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* 6*d.* net.

Continuous and Alternating Current Machinery. By J. H. Morecroft. Pp. ix+466. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s.* 6*d.* net.

Forty-Fifth Annual Report of the Trustees of the American Museum of Natural History, 1913. Pp. 192+plates. (New York.)

Geologischer Führer durch Nordwest-Sachsen. By E. Krenkel. Pp. viii+202+xiv plates. (Berlin: Gebrüder Borntraeger.) 4 marks.

Report of the Danish Biological Station to the Board of Agriculture. By Dr. C. G. J. Petersen. Pp. 67+6 plates+3 charts. (Copenhagen.)

DIARY OF SOCIETIES.

TUESDAY, April 14.

Royal Anthropological Institute, at 8.15.—Some Hopi Textiles from the Pueblo of Hano: Miss B. F. Marreco.

WEDNESDAY, April 15.

Royal Meteorological Society, at 7.30.—

Aeronautical Society, at 8.30.—The Value of Ballooning as a Training for Flying: G. Brewer and Major E. M. Maitland.

Royal Microscopical Society, at 8.—The Insect Pests of Wheat Crops: F. Enock.

THURSDAY, April 16.

Concrete Institute, at 7.30.—The Design of Steel and Reinforced Concrete Pillars with special reference to Secondary and Accidental Stresses; O. Faber.

Institution of Mining and Metallurgy, at 8.

FRIDAY, April 17.

Malacological Society, at 8.—Notes on Australian Mactridæ: E. A. Smith.—On the Generic name Martensia, Semper: Some more notes on Polyplacophora, part I.: T. Iredale.—Description of a new recent Pholadomya from Tasmania: C. Hedley and W. L May.—Description of a New Helicoid from South Australia: G. K. Grude.

Junior Institution of Engineers, at 8.—A Few Typical Carburetters: R. S. Fox.

SATURDAY, April 18.

Association of Economic Biologists (at Royal College of Science), at 10 a.m.—The Organism of Common Potato Scab. (*Actinomyces scabies.* (Thaxter) Güssow): H. T. Güssow.—Potato Diseases: A. S. Horne.—Insects causing Blotch on Potato Foliage: A. S. Horne and H. M. Lefroy.—Standard Fungicides and Insecticides: A. G. L. Rogers.—Observations on *Aphis rumicis*: J. Davidson.—The Golf Green Fly: A. W. Westrop.—Observation on the Winter Stage of the American Gooseberry Mildew. (*Sphaerotheca mors-Uvae*): E. S. Salmon.—The Darkening of Oak: P. Groom.—The Phytopathological Conference: A. G. L. Rogers.—Apple and Pear Sucker: P. R. Awati.—An Experiment in House Fumigation: H. M. Lefroy.—Life-history and Habits of *Aleurodes vaporariorum*: E. Hargreaves.

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THURSDAY, APRIL 16, 1914.

"THE GOLDEN BOUGH" COMPLETED.

The Golden Bough. Third Edition. Part vii., "Balder the Beautiful." By Prof. J. G. Frazer. Vol. i. Pp. xx+346. Vol. ii. Pp. xi+389. (London: Macmillan and Co., Ltd., 1913.) Price 20*s*. net.

THE concluding instalment of Prof. Frazer's famous book may be regarded as demonstrating in a vivid manner and at an appropriate juncture the qualities both of itself and of its author. As has been the case with the other editions, this, which, it seems, is final and definitive, contains more than one change of view. It is characteristic of the author's mind that it is receptive of fresh ideas, and grows, instead of hardening into dogmatic attitudes. Prof. Frazer now, for instance, regards the Aryan god, Zeus-Jupiter, as being primarily a god of the sky, as the orthodox view has it, and only secondarily a personification of the oak. The interesting fact, amply proved by statistics, that the oak is more frequently struck by lightning than any other tree is the chief mediating influence between two sets of data. In a similar connection the revised account of the lore of the mistletoe shows cause for supposing that the parasite was believed to be the embodied result of the lightning-flash, "a sort of smouldering thunderbolt," containing within itself the seed of celestial fire.

But it is with a point of extreme importance for history and modern sociology that the most significant change of view is concerned. Prof. Frazer had accepted the explanation of the fire-festivals of Europe, which W. Mannhardt had suggested—namely, that they were in original intention charms to expedite the course and ensure the life-giving operations of the sun. But Dr. Westermarck's researches among the Moors have convinced the author that the fire-festivals are in intention purificatory. This is no mere academic or curious conclusion, as by necessity much of the substance of "The Golden Bough" must be. For "the grand evil which the festivals aimed at combating was witchcraft, and . . . they were conceived to attain their end by actually burning the witches, whether visible or invisible, in the flames." "The wide prevalence and the immense popularity of the fire-festivals provides us with a measure for estimating the extent of the hold which the belief in witchcraft had on the European mind before the rise of Christianity or rather of rationalism; for Christianity, both Catholic and Protestant, accepted the old belief, and enforced it in the old way by the faggot and the stake. It was not until human reason at last awoke after the long slumber of the Middle Ages that this dreadful obsession gradually passed away like a dark cloud from the intellectual horizon of Europe." Here we have the defect of the author's quality, though we gratefully note how well the new theory fits in with modern history, and brings, as few other episodes do, "The Golden Bough" into touch with living humanity. For the fact is that witch-burning and heretic-burning (they are essentially the same thing, as Westermarck has shown) did not become a form of social emotionalism until after the Middle Ages. Nor is the belief in witchcraft dead yet, anywhere in Europe; while its more cultured form, resentment against social abnormality, is one of the strongest forces in modern life.

It is a pleasure to see that Prof. Frazer, as he lays down his pen, promises us yet other works. No man in history has done more for the reasonable soul of the human race and its salvation by sense. Perhaps he may develop "Psyche's Task" into a treatise which shall give us the sociological meaning of religion. In that treatise the study of the modern crowd should be an essential foundation.

A. E. CRAWLEY.

ASSAY OF PRECIOUS METALS.

The Sampling and Assay of the Precious Metals: comprising Gold, Silver, Platinum, and the Platinum Group Metals in Ores, Bullion, and Products. By E. A. Smith. Pp. xv+460. (London: C. Griffin and Co., Ltd., 1913.) Price 15*s*. net.

THE advances in the assay of the precious metals of late years have been directed mainly towards improvement in detail, and have not resulted in any great change in method or in the discovery of new principles. Nevertheless, the minor changes have been numerous, great numbers of useful observations have been made, and it was high time that a new and complete account should be prepared, setting forth the present varied practice, with the considerations on which it is based. The author of this volume is well equipped for such a task, and has produced a valuable treatise which may be taken as authoritative.

Besides gold and silver, Mr. Smith has included the assay of platinum, a course which will be convenient to assayers, on account both of the importance now attached to the ores of platinum and of the increasing use of the metal in jewelry. Moreover, platinum is often associated with gold, and the methods of assaying gold and platinum are so closely allied that they cannot be separately treated. Special attention is devoted to sampling, a subject which is of great interest to assayers, although sometimes neglected by them. Sampling operations being common ground, and by no means peculiar to the treatment of the ores or alloys of any one particular metal, all reference to them is frequently omitted, both in works on metallurgy and in text-books on assaying. There is also a chapter on the laboratory work in a cyanide mill, and a short but adequate account of ore and bullion valuation and sale.

The book compares favourably with its forerunners, both in respect of completeness and accuracy of statement, and the patient care displayed by Mr. Smith in collecting and arranging all the available data might well be envied by his colleagues. There are few changes which can be suggested as desirable in the next edition. It would perhaps be of interest to add to the historical section something as to the evolution of the assay furnaces, balances, and implements generally, say, from the fifteenth century onwards. Another more important addition would be some further discussion on the effects of borax when mixed with a crucible charge. According to many assayers, this influence is always malign, giving low results. Mr. Smith is not precise in his directions as to the proportion of borax to be reserved for a cover to the charge in various cases.

There is also more to be said as to cupel absorption and the use of proofs or checks. Bullion assayers have long recognised that the determination of the absorption of gold and silver by a particular brand or batch of cupels is not enough, and that the variations in the temperature, amount of draught, etc., appreciably affect the loss. Accordingly, they use check assays for every determination. Ore assayers are often too easily satisfied on this head, or in the alternative subject themselves unnecessarily to the inconvenient course of fusing the cupels. If cupel loss were determined by the use of checks for each cupellation or batch of assays, the extra work would, in the opinion of the reviewer, be more than repaid by the increase of accuracy. In any case, the matter should be faced and fully discussed. Lastly, exception may be taken to the statement on p. 201 that it is necessary to remove the cupels immediately after the button has brightened (what exactly does Mr. Smith mean by "brightened"?). Experience generally, and especially the work of Mr. Wilkes (*J. Chem. Met. and Min. Soc.*, 1905, vol. v., p. 237) is not in favour of this contention.

There is, however, little to criticise in this handsome volume. It may safely be placed in the hands of students, and will be of the greatest value to assayers as a book of reference.

T. K. R.

SEISMOLOGICAL PHYSICS.

Modern Seismology. By G. W. Walker, F.R.S. Pp. xii + 88 + 10 plates. (London: Longmans, Green and Co., 1913.) Price 5*s*. net.

THE first thing to strike one, on glancing through this book, is the absence of an index; the second is the absence of footnote references; and the third is an introduction which, purporting to be a history of the progress of modern seismology, contains about as many errors, of misstatement and omission, as can be crowded into five pages of print. But, once the book proper is begun, these unfavourable impressions disappear, and we find an excellent introduction to the study of that modern seismology which is very remote from earthquakes.

The author's qualification to deal with the subject is said to be his experience in having set up at Eskdale Muir, and for a short time taken charge of, a set of modern seismographs of various types, and the book exhibits at once the drawbacks and the advantages of this limited justification. On one hand, the author's acquaintance with the literature of the subject is evidently limited; for instance, he makes several references to Lord Rayleigh's investigation of surface waves in solids, but ignores Prof. Lamb's later and more apposite work, and in more purely seismological work the reader might well leave the book with the entirely erroneous impression that only three names—Wiechert, Zöppritz, and Galitzin—count as really important, and that their importance is in the order of mention. On the other hand, the recentness and brevity of the author's acquaintance with the subject leaves him in close touch with the difficulties and doubts which beset the beginner, and, being a practised observer in other branches of physics, and writing from a first-hand and current experience, he has produced a lucid and sufficient introduction to the subject.

Beginning with the general dynamical theory and principles of construction of modern seismographs, which is a clearly put, concise, but withal sufficient, account of the subject, he goes on to deal with the character of wave motion recorded by them and the interpretation of seismograms, traversing practically the whole of the ground covered by what is known as the modern seismology, and forming an excellent introduction to that branch of the science. The book deserves, and will doubtless run to, a second edition, when the author will be able to revise the references to earlier work on earthquakes proper, which are almost uniformly erroneous in the present issue. In spite of this it may confidently be recommended, not merely to those who approach the subject for the first time, but to the attention of practised workers, who will find both interest and advantage from being brought into contact with those elemental principles and difficulties, which are apt to be lost sight of as they advance along their special lines of research.

PURE MATHEMATICS.

(1) *Plane Geometry.* By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix + 213 + xxxi. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 3*s.* 6*d.* net.

(2) *Higher Algebra.* By Dr. W. P. Milne. Pp. xii + 586. (London: Edward Arnold, 1913.) Price 7*s.* 6*d.* net.

(3) *The Twisted Cubic: with Some Account of the Metrical Properties of the Cubical Hyperbola.* By P. W. Wood. Pp. x + 78. (Cambridge: University Press, 1913.) Price 2*s.* 6*d.* net.

(4) *Graphical Methods.* By Prof. Carl Runge. Pp. viii + 148. (London: Oxford University Press; New York: Columbia University Press, 1912.) Price 6*s.* 6*d.* net.

(5) *Einführung in die Mathematik für Biologen und Chemiker.* By Prof. L. Michaelis. Pp. vii + 253. (Berlin: Julius Springer, 1912.) Price 7.80 marks.

(6) *Théorie des Nombres.* By E. Cahen. Tome Premier. Le Premier Degré. Pp. xii + 408. (Paris: A. Hermann et Fils, 1914.)

(1) THIS text-book, written by two American professors, is arranged on lines similar to those of modern English text-books. Fewer theorems, more experimental geometry, and numerous practical applications are its chief characteristics. In placing properties of areas after those of circles and similar figures, the authors have adopted a change of order, which we believe will eventually become general. The idea of similarity is so fundamental and at the same time presents comparatively so little difficulty, that it is in our view regrettable that in many examination syllabuses, and consequently in most school courses, it should be postponed to a late period. In fact, it is probably true to say that many boys leave school without any knowledge of what is one of the most valuable, practical, and important branches of geometry.

(2) There are in this volume distinct merits and a certain originality of treatment such as will appeal to many teachers of the modern school. No attempt has been made to develop the subject in a rigorous and logical fashion from the fundamental axioms of number, and we agree with Dr. Milne's opinion that students at this period of their training are ill-fitted for what is almost a philosophical discussion. But at the same time it is becoming generally recognised that the harm done by inculcating incorrect notions of limits, convergence, etc., is so serious and so difficult to remedy that many teachers have, with little assistance from current text-books, been taking their scholarship candidates through a course of serious analysis. They will undoubtedly welcome the publication of this treatise, which with admirable clearness and with an abundance of detailed explanations and illustrations, sets out the lines upon which accurate investigations of the existence of limits and the convergence of single and double series must proceed. More than half the book is occupied with work of this character.

The scope of treatment is best indicated by an enumeration of the headings of the chapters:—Rational numbers; irrational numbers; summation; binomial theorem; permutations and combinations; exponential and logarithmic series; continued fractions; theory of equations; determinants; miscellaneous theorems. In his selection and arrangement of material, the author has, therefore, departed considerably from the customary plan. What little "Theory of Numbers" there is, comes in the first chapter; the usual account of probability has been considerably curtailed; diophantine problems and inequalities receive very brief treatment; and the chapter on permutations follows, instead of precedes, the binomial theorem. There is a good collection of examples at the end of each chapter; we regard, however, as unfortunate the omission of any intermediate sets. Clearly it is undesirable for a student to read the whole of a chapter before doing any examples, and the result of grouping them at the end is to saddle the teacher with the burden of selection.

The final collection of four hundred miscellaneous problems and a number of questions of an essay type call for special notice. Teachers and pupils alike will probably feel the need of an index. Dr. Milne has produced an essentially scholarly work, and we have no hesitation in classing it with those books which are exercising a wholesome and valuable influence on mathematical teaching.

(3) It is curious that no systematic account should have been hitherto published of the properties of the space curve of the third order, although many mathematicians have given their attention to the subject, the fruit of which is to be found in a number of isolated memoirs and, incidentally, in a few treatises, as, for example,

in Grace and Young's "Algebra of Invariants," where the invariants and covariants of a binary cubic are interpreted in terms of the geometry of the skew cubic. This is now remedied by Mr. Wood's tract, which discusses the subject *ab initio*. The first section deals with the projective properties of the curve, developed analytically with the use of homogeneous coordinates, and the second is specially concerned with the cubical hyperbola (the case in which the curve has three real and distinct points at infinity), and discusses the properties of asymptotes, diameters, vertices, centre, axis, inscribed and circumscribing quadrics, the rectangular cubical hyperbola, etc. No one who is interested in geometry can fail to appreciate the collection of properties which Mr. Wood has made, and many will, no doubt, be encouraged by the way in which the initial stages have been simplified, to pursue the subject beyond the limits which space has here rendered necessary.

(4) The purpose of this book is to supply the theoretical basis upon which graphical methods rest, and to discuss in general terms the manner in which applications may be made to shorten the labour involved in the heavy computation with which the physicist and engineer are so often faced. In many cases special graphical methods have been invented to cope with a particular kind of problem, and in view of the fact that there is little inter-communication between those working in different spheres, the opportunity of making use in one department of a device that has been of value in another is often missed, on account of the failure to recognise the generality of the principle which has been employed. The subject-matter is divided into three sections: the first deals with graphical arithmetic, the evaluation of integral functions, and the treatment of complex quantities; the second with the representation of functions of one or more variables, the principle of the slide rule, and the idea of conformal representation; and the last with the calculus and the solution of differential equations.

(5) This course of pure mathematics is most distinctly a lower limit of the equipment every scientific student should possess. The ideas of the calculus are at last beginning to find their way into the ordinary curriculum, more rapidly on the Continent than in England, and the time cannot be far distant when it will be impossible for boys who specialise in chemistry or physics to leave school ignorant of infinitesimal methods. The book deals with revision of arithmetic, algebra, geometry, and trigonometry; graphs of functions; differential and integral calculus, with special reference to expansion in series; and differential equations. The sections of the calculus make rather dull reading, little indication being given of the nature of the applications that it permits. The systematic treatment of what may be called the grammar of the subject should, however, enable the reader to acquire some degree of facility in performing ordinary operations.

(6) What is the criterion that distinguishes the theory of numbers from other branches of analysis? To this question, M. Cahen makes the following reply:—"The Theory of Numbers is a science in which division is *possible* only in special cases, whereas elsewhere division is *impossible* only in special cases." And this statement gives in brief the limits he has set himself in this treatise. The first eight chapters deal with addition, multiplication, subtraction, and divisions of integers, H.C.F. and L.C.M., and fractions; the next four with systems of diophantine equations of the first degree; then follow chapters on linear substitution and groups, linear and bilinear forms, congruences, matrices, prime numbers.

The treatment is thorough in character, and the work is set out so clearly that no student, however small his previous knowledge may be of the theory of arithmetic, should find it difficult to follow the argument; and if he reads through this volume carefully and tests his progress by working out some of the examples provided, he should obtain a firm grasp of this important modern subject. Text-books such as these form an admirable preparation for the student who wishes to make a more specialised study of the subject, for, by giving him a sound groundwork, they make it possible for him to consult intelligently the original memoirs which mark the growth of the theory, and which no text-book, however comprehensive, can in reality replace.

OUR BOOKSHELF.

Dental Diseases in Relation to Public Health. By Dr. J. Sim Wallace. Pp. viii+90. (London: Office of *The Dental Record*, 1914.) Price 3*s*. net.

This book consists of three chapters. They are addresses given by the author in "response to requests." Chap. i. sets forth in detail the prevalence of dental diseases, the serious effects they exercise on general health—especially during childhood—and the methods by which such diseases may be prevented. There are, however, within its pages statements based on loose figures, which are calculated to mar the effect the writer has in view by causing an impression of exaggeration of unverified inference. On the strength of the statement—itself too wide a generalisation—that 75 per cent. of the total population have irregularities of the teeth, we have presented to us the wild statement that "the number of teeth which are pouring pus into the buccal cavity may be estimated, at least has been estimated, at 200,000,000."

Chap. ii. contains a fairly wide description of the function of mastication, and of the effects of saliva on various foods. Chap. iii., on "Children and Dental Disease," is to a large extent a repetition of parts of chap. i., but clothed in different language.

We do not consider these chapters are a serious contribution to the literature of public health. Careful perusal of them impresses upon us the conclusion that, while condemning physiologists and medical men for their shortcomings in dental hygiene, the author is unduly confident in his own exaggerated and unbalanced opinions. He recommends prevention of dental disease by methods of dieting, which "show beyond all doubt that dental caries is not only preventable, but that it is easily and surely preventable."

The enormous benefit bestowed by early treatment as a method of prevention is not admitted by the author, who asserts that, "compared with modern methods of prevention, however, treatment must be regarded as a failure." He is equally clear that sugar should not be regarded as a wholesome and cheap food for children, but as a large and important factor in the production of dental caries. In these opinions we doubt if many physiologists will join him.

Savants du Jour: Albin Haller, Biographie, Bibliographie Analytique des Ecrits. By Ernest Lebon. Pp. 120. (Paris: Gauthier-Villars; Masson et Cie., 1913.) Price 7 francs.

There is something to be said for the publication of a man's biography during his lifetime. He is at least able to participate in the pleasant things that are said of him. Mr. Ernest Lebon has undertaken the task of writing the lives of the "Savants du Jour," and so far he has completed seven, the latest of the series being the life of Prof. Albin Haller. Son of a joiner and cabinetmaker, of Thaun-St.-Amarin, in the Vosges, Haller was apprenticed to a local apothecary until the outbreak of the Franco-German War, when he served as hospital assistant. At its conclusion in 1871, he left his native town to follow the fortunes of his teacher, M. Gault. When the staff of the Strasburg University was transferred to Nancy, Haller entered as a student of pharmacy, and in 1873 became lecture assistant in chemistry. He quitted the school of pharmacy in 1884 in order to fill the chair of chemistry. He was elected corresponding member of the Academy of Sciences, in 1891, and in 1899 was asked to take the chair vacated by the death of Prof. Friedel as professor of organic chemistry at the Sorbonne. In 1911 he was made commander of the Legion of Honour, and since then he has received widespread recognition by native and foreign scientific bodies.

His principal researches are mainly in the domain of organic chemistry.

In connection with his studies in the camphor group, he not only obtained a great variety of new and interesting derivatives of camphor and borneol, but among them the homologue of camphoric (homocamphoric) acid, which on distillation of its lead salt gives camphor, and in this way he succeeded in effecting a partial synthesis of camphor. The long list of researches which have emanated from his laboratory, in addition to his numerous literary contributions on scientific subjects, give evidence of an unusually active and fruitful career.

J. B. C.

A Course of Practical Work in the Chemistry of the Garden. By D. R. Edwardes-Ker. Pp. 40. (London: John Murray, 1914.) Price 1s. 6d. net.

One of the results of the foundation of a diploma in horticulture by the Horticultural Society is certain to be an improvement in the method of education of horticultural experts. The number of appointments in this direction tends constantly to increase, and now that the Board of Agriculture has established a horticultural branch, the competent expert finds the possibility before him of a highly successful career. In order to meet the demand for text-books that is certain to arise, Mr. Edwardes-Ker has collected a set of experimental lessons to be carried out in a chemical laboratory, and requiring only such limited knowledge of chemistry and of manipulation processes as will be available in the circumstances.

The book is divided into four chapters, headed respectively, "The Chemistry of Plants," "The Chemistry of Soils," "The Chemistry of Manures and Fertilisers," and "The Chemistry of Sprays and Washes." The experiments are simple and well chosen, and should prove of distinct value both to the student and the teacher. They will, of course, require to be supplemented by a suitable series of lectures setting forth the bearing of the facts thus ascertained on the growth of plants, and, in order to bring this out more clearly, we should like to see some pot experiments added. Pot experiments can be made quite simple enough for the purpose, and satisfactorily demonstrate many important phenomena that laboratory exercises alone can never bring out.

A Practical Manual of Autogenous Welding (Oxy-Acetylene). With a chapter on the Cutting of Metals with a Blowpipe. By R. Granjon and P. Rosemberg. Translated by D. Richardson, Pp. xxii+234. (London: C. Griffin and Co., Ltd., 1913.) Price 5s. net.

Autogenous welding consists in uniting metals by fusion without the intervention of solder. Ordinary welds may be effected by heating in a forge, but the local application of heat by an electric current or by the heat of an intense flame is more properly called autogenous welding in contradistinction to the junction of metals made by solder. The work before us treats of welding as done by the oxy-hydrogen and oxy-acetylene blowpipe, the introductory matter on soldering and electric welding being outside the main purpose of the work. The oxy-hydrogen weld was used before oxy-acetylene, but the latter is now the most common. Acetylene burnt with an equal volume of oxygen gives a temperature which is 1000° C. higher than the oxy-hydrogen flame. For successful welding minute attention to the details of construction of the blowpipes is necessary, and the author describes the forms of blowpipes used and the generators for producing acetylene economically.

The enormous extent to which this form of welding is employed in the arts may be gathered from the descriptions of iron and mild steel welds that can be done *in situ* on large pieces of structures and machinery. From repairing a large rudder of a steamer to the delicate junction of rose-petals in ornamental wrought iron work, the usefulness of the oxy-acetylene blowpipe extends, but perhaps the most important application of the blowpipe is in the cutting of metals and removing rivets. The weakest part of the work is in the translation, which in places leaves much to be desired.

Ambidexterity and Mental Culture. By Dr. H. Macnaughton-Jones. Pp. 102. (London: William Heinemann, 1914.) Price 2*s.* 6*d.* net.

THE author's object in this little volume has been to state briefly the conclusions that may be drawn from the authoritative opinions of physiologists, psychologists, and teachers in different parts of the world as to the advantages of ambidexterity and the desirability of teaching it. Recent experience is drawn upon, and accounts of "Eurythmics" and the Montessori system are included.

LETTERS TO THE EDITOR.

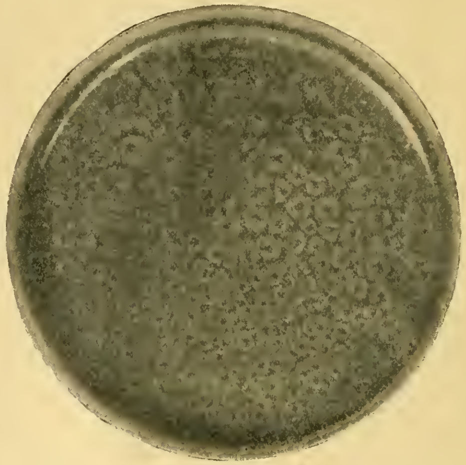
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cellular Structure of Emulsions.

WHILE preparing emulsions of radio-active minerals in alcohol for *α* ray examination, my assistant, Mr. E. K. Denton, directed my attention to the mottled appearance of the surface of the emulsion. Closer examination with a lens or low-power microscope shows that the surface is divided into numerous polygonal cells. At the centre of each cell the liquid is flowing vertically upwards, on the surface horizontally outwards, then downwards at the edges of the cell and horizontally inwards along the bottom; such a circulation, in fact, as would be produced by a vertical doublet at the centre of the cell. The hydrodynamical action of these doublets is no doubt responsible for the cellular structure, and the flow is maintained by the evaporation of the alcohol at these centres.

The effect may be obtained with an emulsion of an insoluble powder in any volatile liquid. I have found it, *e.g.* with carborundum, graphite, and lycopodium in ether, alcohol, or molten paraffin. (Certain powders, such as rouge, fail to show it.) The accompanying photograph (graphite in methylated spirits) shows the general appearance of the surface, but does not give an adequate idea of the sharply rectilinear character of the boundaries of the cells.

It seems possible that this effect is related to the formation of flocculi in the solar photosphere, and even to terrestrial cloud formations of flocculent type. I have not been able to find previous reference to it,



and should be obliged to any of your readers who can supply me with such or otherwise comment upon it

KERR GRANT.

The University of Adelaide, March 1.

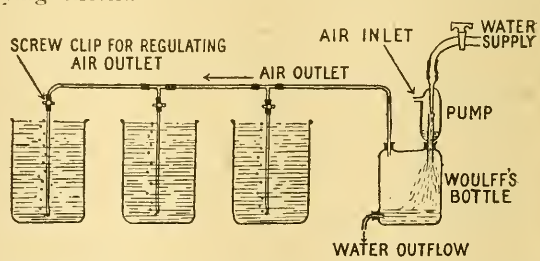
A Simple Method of Aerating Marine and other Aquaria.

THE following method is adapted for aerating aquaria, especially those which contain microscopic organisms, such as Amœba, Vorticella, Hydra, Desmids, Diatoms, and delicate Algæ. Further, the method is admirably suited for marine aquaria, and when once set up the sea-water does not require to be renewed but only maintained at its original level in the aquarium by the addition of distilled water.

The apparatus required is readily obtained and fitted up; and as the cost is only a few shillings, it should appeal to all teachers of nature-study. Apart from the fascination of having several fresh-water and marine aquaria maintained in perfect condition, there is the educational value to be considered.

All that is required is a water pump, a Woulff's bottle, some glass tubing, a short length of rubber tubing, and one or two screw clips.

The apparatus is fitted up as shown in the accompanying sketch.



The pump is connected with the water supply tap, and when the water is turned on it passes through the pump, dragging air with it into the Woulff's bottle; here the air and water separate, and since the water outflow is checked, the air fills the upper part of the bottle, and becomes compressed. The air being under pressure may either blow the water out of the bottle or bubble through the aquaria; the latter being the path of least resistance, produces the desired result, namely, complete aeration of the aquaria.

ELLIS W. GILDERSLEEVES.

Physiological Laboratory, Bedford College, Regent's Park, N.W.

THE RED SEA COAST.[1]

MR. CROSSLAND, as marine biologist to the Sudan Government, has been resident for some years in the neighbourhood of Suakin, and has had ample opportunities to become intimately acquainted, not only with this portion of the Red Sea coast, but also with the inhabitants of this interesting part of Africa. Living in the course of his work in close acquaintance with some fifty or sixty employees, among whom were Arabs from Sinai and Yemen, Negroes from the Upper Nile, and especially Hamites, the descendants of the original inhabitants of north-eastern Africa, he finds that they range in intelligence between much the same limits as the uneducated class of European lands. The social and religious conditions of these three nationalities are well described and illustrated by numerous instances which came under the author's notice, and his descriptions of them provide a valuable addition to our knowledge of these peoples. In the arid region which they inhabit, the life of the Hamitic nomad tribes is a hard one, and the extremely local character of the scanty rainfall and the consequent scarcity of forage for their camels and flocks impose on them the necessity for constantly shifting their encampment. While the Hamites are the camel-owners of the district, the Arabs and their Negro slaves hold almost a monopoly of the sea traffic in their coasting vessels, "Sambuks," in which they cruise up and down the Red Sea, and it is on the coast-belt that they come into contact.

A short chapter on corals introduces us to an account of the building of the reefs. Here a good account is given of the growth of the shore-reefs, with examples from the Red Sea and from other places, and of the erosion and deposition which is going on at various points by the tidal currents where these are sufficiently developed. At Port Sudan the tidal range is extremely small, being rarely more than 30 cm., but at other parts of the Red Sea this is greatly exceeded. The book concludes with a very instructive chapter on the tectonic structure of the Red Sea, which is a welcome addition to Suess's general discussion of it, and to the more detailed work of Hume, Ball, and Blanckenhorn in the northern portion.

Mr. Crossland considers that the sandstone hills of the coastal plain were deposited previous to the extensive faulting of the Red Sea area, which eventually resulted in three parallel fault-blocks. Of these the first and nearest to the Red Sea hill-ranges once formed a barrier reef near the foot of the mountain, and a coastal plain was formed behind it. Further movements produced an outer barrier reef on another fault block, and within this now a coastal plain has been built up. The present barrier itself is being formed on a third and outlying fault-block, and the deep lagoons so typical of this coast lie within it. These descriptions,

An elderly Bishari. From "Deserts and Water Gardens of the Red Sea."

which have largely appeared in the *Journal of the Linnean Society*, show what an interesting field awaits the physiographer and the geologist along these shores of the Red Sea. The descriptions both of the people and of the country are excellently true to life, and furnish an interesting and accurate account of a little-known region, though the discomforts of residence there during the hot season

[1] "Desert and Water Gardens of the Red Sea." Being an Account of the Natives and the Shore Formations of the Coast. By Cyril Crossland. Pp. xv+158+xl plates. (Cambridge University Press, 1913.) Price 10s. 6d. net.

of the year are made light of, and the difficulties which the arid climate offers to the detailed examination of an extensive tract of such country have to be experienced in order that they may be fully appreciated H. G. L.

THE LAWES AND GILBERT CENTENARY FUND.

JUST a hundred years ago was born John Bennett Lawes, followed three years later by his life-long collaborator, John Henry Gilbert; together they carried on their scientific work until the end of the nineteenth century, and now preparations are being made to commemorate the year of Lawes' birth by rebuilding the laboratory in which so much of the pioneer work in agricultural science was done. The issue of the Annual Report on the Rothamsted Experiments reminds us of the historic claims of that institution to all the assistance the public can give it.

Lawes began his agricultural experiments so far back as 1838, but though those early essays led to the invention of superphosphate and so incidentally to the fortune from which he so liberally endowed the Rothamsted Station, the experiments, properly speaking, did not begin until 1842, when Gilbert became associated with them. From that time some of the famous fields began to take shape, and by 1852 had settled down to that scheme of manuring which has never since been changed; in consequence, the plots now supply data as to the effect of fertilisers both upon the crop and upon the soil which are not merely unrivalled in their trustworthiness, but are constantly being re-interpreted as the science of the nutrition of the plant develops. In 1855 the laboratory was built from subscriptions raised as a testimonial to the value of Lawes' work, and it is this laboratory, now out of date and becoming structurally unsound, that the Rothamsted Committee seeks to replace.

Lawes died in 1900, Gilbert in 1901, and that first long and honourable chapter in the history of Rothamsted was closed. With the appointment of a new Director, Mr. A. D. Hall, in 1902, came the desire for a fresh outlook upon the old experiments; new points of view had arisen, particularly the physical and biological aspects of the soil had become important. The first necessity was to get together a body of workers, for one man could no longer cover so complex a field, and to find adequate accommodation for them, because the arrangements of the old laboratory, though equal to the routine determinations which Gilbert needed, were extremely primitive. Unfortunately, the endowment of the Lawes' Trust provided no margin for extension; still the laboratory was reformed, a few voluntary assistants were secured and new ground broken. After a time Mr. J. F. Mason built a new wing for bacteriology and enabled Dr. H. B. Hutchinson to join the staff, and a little later the Goldsmiths' Company added to the endowment so that the services of Dr. E. J. Russell could be secured.

Up to that time no assistance came from Government, but with the creation of the Development Fund in 1910, the Rothamsted Station became recognised as the Institute for the investigation of the soil and the nutrition of the plant, and received an adequate endowment. The first result was that the Committee was able not only to add some experienced workers to the staff, but also to take a long lease of the home farm containing the classic fields and to embark upon the erection of an additional laboratory with all modern conveniences of electric supply, vacuum and air current, etc. At that point Mr. Hall resigned the Directorship, and was succeeded by Dr. Russell, who has no sooner got the new laboratory opened than he has set about the replacement of the old one which, even were it adaptable to modern methods of work, has for years been giving trouble owing to original defects in construction.

Subscriptions have been received from all parts of the world, the farming societies, large and small, in Great Britain, have contributed in a way that shows their increased appreciation of research, but nearly 1000*l.* are still wanted to complete the 6000*l.* that it is necessary to raise from the public. The laboratory is expected to cost 12,000*l.*, towards which there is reason to expect the Development Commissioners will give a sum equal to that raised from other sources, so now is the time for everyone interested in the welfare of this *doyen* of institutions for agricultural research to send along their donations from which the Rothamsted Station will reap a double benefit.

THE LIFE-HISTORY OF THE EEL.[1]

MANY articles in NATURE have dealt, during recent years, with the above subject; but its interest is not exhausted, and we here welcome the appearance of three new contributions to the long-debated question of the eel.

Dr. Grassi's work is the first publication of the Italian Royal Commission on "Thalassography," and in these first-fruits the commission gives promise of a great return from its systematic exploration of the Mediterranean Sea. Mr. Lea's paper is one of the many beautiful and interesting monographs which have already been based on the collections made by Sir John Murray and Dr. Hjort in the deep waters of the Atlantic. Dr. Bowman's paper is a brief but interesting note, based on the work of the Scottish research vessel *Goldseeker*.

In a long and learned introduction Dr. Grassi relates the history of our knowledge of the life-history of the eel; and while this history has been often summarised, it is here told more completely than ever. Dr. Grassi goes back even to Aristotle,

[1] "Metamorphose der Murænoiden: Systematische und Oekologische Untersuchungen "(Text Italienisch). By Dr. Battista Grassi. Pp. x+211 +xv plates. (Jena: Gustav Fischer, 1913.) Price 50 marks.
"Murænoid Larvæ from the *Michael Sars* North Atlantic Expedition, 1910." By Einar Lea. In vol. iii. of the Scientific Reports of the Expedition. Pp. 59+6 plates. (Bergen: John Grieg, 1913.)
"The Distribution of the Larvæ of the Eel in Scottish Waters." By Alexander Bowman, D.Sc. Fishery Board for Scotland, Scientific Investigations, 1912, No. II (December, 1913).

and, telling us that the Sicilians still call the larval eels *casentule,* that is, "earthworms," while the philosopher tells us that the eels spring from "earthworms," γῆς ἔντερα, he inclines to the conclusion that Aristotle knew a deal more about the biology and development of the eel than is actually set forth in his brief recorded references. It was Redi, in the seventeenth century, who showed, with the utmost clearness, that the eels breed out in the open sea, after migrating down the rivers "nel rimpunto della luna," "in the dark of the moon."

Another chapter of the story opens, just 150 years ago to a year, when a certain Mr. William Morris sent to Pennant, from Holyhead, the curious little fish which, in our youth, we used to read of in "Yarrell," under the name of the "Anglesey Morris," or *Leptocephalus morrisii,* as Gronovius had called it. Other similar fishes were from time to time described, until in 1856, Kaup, in a British Museum catalogue, described a number of species, including a certain *L. brevirostris*, from the Straits of Messina. A multitude of naturalists dealt, during the early part of the last century, with these little fishes. Cuvier said that their study was "une des plus intéressantes auxquelles les naturalistes voyageurs puissent se livrer." Johannes Müller, with splendid insight, declared that they were closely allied to the Muraenoids. Carus, in 1861, suspected that they were larval forms of some other fish, perhaps Cepola or Trichiurus, and in 1864 Dr. Theodore Gill asserted that these little Leptocephali were but larval eels, a fine instance of zoological prescience.

A long controversy followed, in which Günther and others maintained that the Leptocephali were not an ordinary necessary stage in the life-history of the eels, but were abnormal larvæ, distorted by an unnatural habitat. At length it was made clear by Dareste, Moreau, and finally and experimentally by Delage, in 1886, that *Leptocephalus morrisii* was the normal larva of the conger. Here begins the series of researches by Grassi and Calandruccio, who between 1892 and 1905 confirmed Delage's account of the metamorphosis of the conger, showed that Kaup's *L. brevirostris* was the larva of the common eel, studied in detail the life-history and metamorphosis of a whole series of other Leptocephalids, and maintained that these little larval fishes were inhabitants of the deep waters, from which sometimes, as in the Straits of Messina, they were brought up to the surface by currents or by whirlpools; just as Yarrell told, long before, of a specimen cast up in the eruption of Graham's Island in the Mediterranean. As was foreseen by Salvatore Lo Bianco, in 1891, the larvæ of the common eel are inhabitants of the deep sea, and three years later Johan Petersen captured the Leptocephalus of the common eel, *L. brevirostris,* out in the Atlantic, south-west of the Faeroe Islands. From that date onwards, together with Prof. Grassi himself, a band of Scandinavian naturalists—Petersen, Hjort, with his pupil Einar Lea, and last but not least, Dr. Johann Schmidt—have carried on the investigation of the metamorphosis and migrations of the eel.[2] Schmidt, Hjort, and Lea have now shown that the main breeding-place of the eel is not only out in the open Atlantic, but is in all probability in the warm and very salt waters of the southern part of the North Atlantic, south and west of the Azores; and an interesting part of Mr. Lea's paper is one in which he discusses the probable duration of the eel's long voyage to its breeding-place, and of the slow return of the young larvæ home. This point is further elucidated by Dr. Bowman, who is able to trace the Leptocephali of the common eel on their way round the west and north of Scotland from about June to August, while by November or December they appear as "elvers" off the coast, and are ready to ascend the rivers in March or April. The Leptocephali of the conger are found off the east coast from December to May.

But there still remain a few points of doubt, and therefore of controversy, on which the learned Italian naturalist and his Scandinavian brethren do not quite agree. These are questions which we would not lightly judge or prejudge, and we may simply say that Dr. Grassi seems to state his case with great fairness, and with a very open mind. Among the points still at issue we may mention two. First, does the eel breed in the Mediterranean? And secondly, are the Leptocephali (at least those of the common eel) inhabitants of the surface-waters, of the bottom, or of intermediate depths? Dr. Schmidt believes that the eel does not propagate at all in the Mediterranean, "conclusione molto sorprendente," as Grassi calls it. He holds that for the Mediterranean eels, as for all those of western and northern Europe, the Atlantic is the one great breeding-ground, and that inwards, through the Straits of Gibraltar, pass the migrating young; while Dr. Grassi still inclines to his old belief that the deeper parts of the Mediterranean are also breeding-grounds. At considerable length Dr. Grassi discusses the other problem, and holds that it is by no means proved, as Dr. Schmidt would have it, that the Leptocephali are dwellers in the upper layers. He refers to the habit, which many species at least of the Leptocephali have, of burrowing in the sand or hiding under stones; he states that he has seen *L. brevirostris* itself actually doing so; and he tells us that in captivity the little Leptocephali avoid the light, and retreat into dark corners of the aquarium. In short, he is unwilling to budge from his old opinion, set forth twenty years ago, that the Leptocephali come only occasionally towards the surface from the great depths which constitute their natural home.

The question is curiously interlinked with the too little-known habits of the sunfish, *Orthagoriscus mola*. Multitudes of Leptocephali are found within the stomach of that fish, and would even seem to constitute its main, though not exclusive, nutriment. Sometimes, and this in itself would seem rather to tell against Prof. Grassi's view, they are still actually living when the fish is

[2] See Dr. Schmidt's article in Nature, August 22, 1912; also Dr. Johann Hjort's communication to Nature of November 24, 1910.

caught and its stomach opened. Now the sunfish is often seen upon the surface, and is harpooned or otherwise captured there; but Prof. Grassi will not admit that this is its normal habitat, but thinks that it only now and then comes up from the greater depths. This is not the usual belief, but it was Lo Bianco's, as Grassi tells us, and Lo Bianco's opinion carries a deal of weight. After all, then, the sunfish may be a denizen of the deep waters, like *Lampris luna*. But, in the few cases where a sunfish has been found to contain other diet than Leptocephali, the stomach was found full of Salpæ, pteropods, and Velellæ, and they had doubtless been fed upon, if not at the surface, at least in the upper layers. If we may at all venture an opinion, Dr. Schmidt seems to have the better of the argument. A minor but curious question is how the sunfish, with its tiny mouth and apparently awkward body, is able to catch, by hundreds and by thousands, these little active, transparent Leptocephali.

D. W. T.

CARTE INTERNATIONALE DU MONDE AU MILLIONIÈME.

The conference of London, which assembled at the Foreign Office in November, 1909, at the invitation of the British Government, drew up an elaborate code of rules for the construction of an international map on the scale of one in a million. In the four years which have passed since that meeting about a dozen sheets in all have been completed, though not so many have been published. It had soon become evident that a second conference was required for two reasons. Certain of the resolutions of London worked badly in practice, and needed modification; while several of the Governments which would be called upon to undertake a considerable share of the work had not been represented in London, and desired to be heard before committing themselves to the scheme.

The second international conference met in Paris, at the invitation of the French Government, in December last, and thirty-three countries were represented by delegates officially nominated, whose resolutions will be submitted to their respective Governments for formal ratification. This official character of the meeting has much practical importance. The scheme had been discussed at successive meetings of the International Geographical Congress for twenty years; it remained inoperative until the first official conference of 1909.

The first business of the Paris meeting was to decide what parts of the London resolutions should stand unchanged, and what was open to discussion. A prompt decision to leave as much as possible untouched cleared the way for the real business of the meeting, which resolved itself into three parts—the revision of the conventional signs; the improvement of the colour scale for the layers, and other details of the representation of relief; and the distribution of the sheets which covered the territory of several Powers. The three commissions which were nominated to deal with these questions chose as their presidents Prof. Penck, Colonel Thiébaut, of the *Service géographique de l'armée*, and Colonel Close, respectively. General Bourgeois, chief of the *Service géographique*, presided over the full conference with admirable firmness and lucidity.

The work of the first commission involved long meetings and animated discussion on the classification of towns and the spelling of place names, which affect different countries in very different ways. A system of town classification which is good for Europe is hopeless for Africa, while the relative claims of population and administrative importance lead to difficulties on a single sheet. The spelling of place names in Eastern Europe is fiercely contestable; the transliteration of African names into European equivalents produces endless trouble on boundary sheets. On these matters no hard and fast agreement was possible; much must be left to the discretion of the establishment that makes the sheet. Minor difficulties in the classification of railways, navigable rivers, and roads were amicably adjusted, and the resulting conventional signs sheet is in many respects a great improvement on that adopted four years ago.

The work of the second commission was very much simplified by the production of experimental variants of the Istambul sheet, which had been prepared by Colonel Hedley in the Geographical Section of the General Staff. Fine black contours, instead of brown, were accepted without difficulty. The ugly and unsatisfactory upper tones of the London colour scale for layer tints found few defenders, and it was not difficult to substitute a scale running into orange and red in place of the old brown and magenta. Above the snow line the layer tint is to be omitted; glaciers are to be distinguished by blue form lines or hachures, and there is liberty to use shading when the contours are not sufficient to bring up the form of the snow peaks. In principle the contour interval is, as before, 100 metres throughout; but this is not always feasible, while the suppression of contours at discretion leads to unnecessary diversity. The remedy was to declare certain contours obligatory (*courbes maitresses*), the others being discretionary.

The third commission laid down the principle that the right to produce a sheet belonged to the country which owned most territory within its limits, and refused to make any pronouncement as to sheets lying wholly in territories which have no cartographical establishments. The significance of the latter decision was lessened by the announcement of the Chinese delegate that topographical establishments were now in active operation in all the provinces of the Republic. The delegates of the South American States came to an important agreement among themselves in regard to the representation of doubtful boundaries.

In the full sessions the decisions of the commissions were ratified without excessive rediscussion, and there was happily no need to settle the awkward question whether delegates of countries which had not produced, and never would produce, a sheet of the map should have an equal voice with others more deeply interested.

In an enterprise needing so much cooperation and exchange of information a central office is necessary. The British delegates had the satisfaction of being authorised by their Government to propose that a central office should be established in England, of which the small expenses should be borne by contributions from the consenting Powers in equal shares. The conference did England the honour of accepting this proposal unanimously, and if the agreement is ratified it is probable that the office will be at the Ordnance Survey, Southampton, with an auxiliary office in London where all information will be available for reference.

It was decided that the official name of the map shall be the French name—"Carte internationale du monde au millionième." A strict adherence to this rule is desirable, especially in indexing and cataloguing the literature which will grow up, in notices, reviews, and lists of published sheets.

The labours of the conference were lightened by the excellent arrangements made for its reception in the Salle d'honneur at the Invalides, and in the rooms of the *Service géographique;* by the cordial attentions of the hosts; and by the splendid hospitality, public and private, extended to the delegates.

The British delegates were Colonel Close (Ordnance Survey), Colonel Hedley and Captain Cox (Geographical Section, General Staff), and Mr. Hinks (Royal Geographical Society), representing Great Britain; Major Tandy (Survey of India) representing India; and Major Richardson, representing New Zealand.

INTERNATIONAL CONVENTION ON PLANT DISEASES.

SHORTLY after the final sitting of the International Phytopathological Conference, which was held at Rome last month, an official statement was issued, and extracts from it were given in our issue for March 26 (p. 90). The text of the draft convention which was prepared at this conference has now been issued by the International Agricultural Institute at Rome, and the Governments which were represented on that occasion will be invited to consider whether they will signify their formal acceptance of the proposed agreement. Their decision will depend on political and administrative reasons with which we are not here concerned, but the suggestions contained in the document mark an advance in public opinion on the subject of plant diseases of great interest to men of science, which cannot be entirely overlooked. The delegates of thirty independent States have decided that it is desirable that a uniform procedure should be adopted to control the spread of those diseases which have in the past done so much injury to agricultural and horticultural crops, and, indeed, are still doing so, and that this procedure should include both the scientific study of the insect and fungus pests at one or more Government phytopathological stations in each country, and the application of remedial measures by administrative order where these pests exist.

The official acceptance of this policy would in any case give a great stimulus to the study of applied biology, and would tend to concentrate the attention of entomologists and mycologists on economic problems. But the scheme contemplated by some of the articles of the convention is likely to be productive of even more important results. It was evidently felt impossible to prepare a list of dangerous diseases applicable to all countries, and while, on one hand, it was decided not to legislate for those diseases which attack agricultural crops, such as seeds, grain, potatoes, and other "articles de grande culture," each Government is invited to prepare a list of those diseases against which it wishes to be protected. The preparation of such a list is bound to be difficult, since many of the diseases which are comparatively harmless in a country where they have been established for many years are apt to assume a virulent character when introduced into a country where they are unknown. The ravages caused by the Brown Tail Moth (*Euproctis chrysorrhoea*) and the Cotton Boll Weevil (*Anthonomus grandis*) in America, by the Vine Louse (*Phylloxera vastatrix*) and the American Gooseberry mildew (*Sphaerotheca mors-Uvae*) in Europe, are familiar examples. The attention of official plant pathologists will have, therefore, to be directed not only to the study of the pests of their own country, but also to those of other countries the character of which is such that they might prove dangerous if introduced.

The field for this kind of research is, of course, very wide; but lest an opening should be given to unreasonable and alarmist measures likely to cause a serious disturbance of trade, it is laid down in a very important article what are the conditions on which the list must be prepared. It is wisely declared that the list must be as restricted as possible, and must not include any of those common pests which are widely distributed in almost every country, and are well established there. (Les espèces banales, dont la dispersion déjà ancienne s'étend à presque tous les pays.) Moreover, the pest must be epidemic in character, and destructive, or at least very injurious, in action, as well as be easily capable of being conveyed on living plants, or parts of plants.

In those cases where the pest is already known to be of such a character in its native home or in some country into which it has already been introduced, its inclusion in the list is a foregone conclusion, and there will be little hesitation about including the San José Scale (*Aspidiotus perniciosus*) or the Mediterranean Fruit Fly (*Ceratitis capitata*), the Black Knot (*Plowrightia morbosa*) or the Chestnut disease (*Endothia parasitica*).

But in other cases a difficulty will arise. Where experience cannot speak with certainty, a scientific reason must be urged, and it will be necessary to formulate a series of deductions from the life-history of the insect or fungus which would justify a presumption that in different surroundings the pest might prove epidemic as well as destructive to plant life, or at least injurious to the crop. No doubt it will be possible, in the course of time, to declare with more accuracy than at present what are the circumstances in which such conditions might arise; but it will require a long and careful study, not only of plant hygiene, but also of the limits of the powers of adaptation to environment possessed by parasitic organisms, under the stimulus of altered climatic and cultural conditions, as well as freedom from injurious influences. This article in the proposed convention will, if adopted, have a marked influence on the trend of economic biology and plant pathology.

NOTES.

A collection of rock specimens of considerable historic interest has just been presented to the Department of Minerals of the Natural History Museum. The specimens in question were collected in Arctic North America by Sir John Richardson, who accompanied Sir John Franklin's Arctic Expeditions of 1819–1827. They have since that time been kept in the museum of the Royal Naval Hospital at Haslar, but inasmuch as the fossils collected in the same Arctic expeditions are in the National Museum at South Kensington, it was felt to be in the fitness of things that the rocks should be also preserved there. An application was accordingly made to the Lords of the Admiralty to sanction the transfer of the specimens from Haslar to Cromwell Road, with the result that, as we have stated, they are now in the Department of Minerals.

On Tuesday next, April 21, Dr. Walter Wahl will deliver the first of two lectures at the Royal Institution on problems of physical chemistry: (1) study of matter at high pressures, (2) study of matter at low temperatures; on Thursday, April 30, Dean Inge will begin a course of three lectures on the last chapter of Greek philosophy: Plotinus as philosopher, religious teacher, and mystic; and on Saturday, April 25, Dr. T. E. Stanton will commence a course of two lectures on similarity of motion in fluids: (1) the theory of similarity of motion in fluids and the experimental proof of its existence, (2) the general law of surface friction in fluid motion. The Friday evening discourse on April 24 will be delivered by Dr. F. W. Dyson, the Astronomer Royal, on the stars around the north pole.

Prof. E. Heyn, of Berlin, is this year to deliver the annual May lecture before the Institute of Metals, upon the subject of "Internal Strains in Cold Wrought Metals, and Some Troubles Caused Thereby." The last May lecture, by Sir J. Alfred Ewing, was on the subject of "The Inner Structure of Simple Metals," and previously Dr. G. T. Beilby had lectured on an allied subject, "The Hard and Soft States in Metals." Prof. Heyn's discourse will be given in the building of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W., under the chairmanship of Admiral Sir Henry Oram, president of the Institute of Metals, on Tuesday, May 12, at 8.30 p.m. The secretary of the Institute, Mr. G. Shaw Scott, of Caxton House, Westminster, S.W., will be glad to forward tickets to any readers who may desire to be present at the lecture.

Prince Galitzin will preside over the fifth meeting of the International Seismological Association, to be held early next September, in St. Petersburg. The exact date of the meeting is not yet fixed, but the provisional programme has just been issued. Reports will be presented by the committees on microseisms, on tides in the earth's crust, the bibliography of seismology, the catalogues of earthquakes prepared by the permanent committee, and the uniformity in the arrangement of seismological bulletins. It will be proposed that a new station shall be founded at Bergen, that a reserve supply of seismographs should be kept for occasional or temporary use, and it will be urged that all seismographs should be provided with suitable "damping" arrangements, and that correct time should be supplied by telegraphic signals to all earthquake observatories. Among the papers promised may be mentioned those of the president on the analysis of seismograms, the comparative study of seismograms from different stations, and on observations of the angle of emergence, and of Prof. Omori on the tromometric observations made during the recent eruptions on the flanks of the Asama-yama.

News has just reached us of the death on February 18, in his forty-sixth year, of Dr. J. Huber, director of the Museu Goeldi, Pará, Brazil.

Mr. G. H. Martyn, writing from Biarritz, says that on March 30, at the end of a bright day with light winds, the sun appeared to pass through a clear sky and set in the sea, from which it seemed immediately to start rising again. "The reflecting layer of air was not wide enough to reflect the whole disc of the sun, but a band having a width of a third of the sun's diameter, so that the appearance was of the sun rising and passing behind a bank of invisible clouds."

In the *Irish Naturalist* for March Mr. N. Colgan contributes an article entitled "Field Notes on the Folk-lore of Irish Plants and Animals." He shows the current traditional knowledge of the transmogrification of species, and that of sexes in plants. Thus, the royal fern is believed to be the wild rannyock or common bracken, and the spargantium or bur-reed the wild shellistring or flagger. The people identify a he- and she-bulkishawn or ragweed, the latter turning out to be the common tansy. On the Irish coasts the common limpet or *patella* is firmly believed to develop out of the acorn-shell or *balanus* which covers the rocks. The grimmest belief about the elder is thus stated by a car-driver: "That's the elder tuff. It's a bad thing to give a man a scelp of that. If you do, his hand 'ill grow out of his grave."

A considerable portion of the second number of vol. v. of the Journal of the Federated Malay States

Museums is devoted to various groups of Malay aboriginal tribes, Mr. C. B. Kloss communicating a number of measurements and photographs of Biduanda (Mantra) of the Ulu Kenaboi, Jelebu, while Mr. J. H. Evans furnishes notes on the same tribe, as well as others relating to the natives of Lenggong, Upper Perak, and yet others on those of the Ulu Langat, Selangor. The Lenggong aborigines, although derived from a Negrito stock, speak a Sakai dialect, like the pure (Negrito) Semang of Grit, from which, however, they differ by their lighter colour. Like many of the other native tribes, they object, however, to be called either Semang or Sakai, the reason for this being that both these names are commonly used by the Malays as terms of reproach. The people of the Ulu Langat and Ulu Kenaboi, who are all of one race, are more or less pure-bred Sakai.

In the issue of *L'Anthropologie* for November-December, 1913, Mr. O. G. S. Crawford discusses the question of prehistoric trade between England and France. He directs attention to the discovery in southern England of certain stone celts, vases, and bronze palstaves of Continental types. These seem to have reached this country from the Cotentin peninsula, in which prehistoric remains, especially hoards, are abundant. In support of these views he further considers the position of sites in this country sacred to the worship of St. Catherine. These lie in the western half of our south coast, but are wanting in the eastern half. He suggests that her wheel is a symbol of light connected with a Gaulish divinity, known as Lhud in Britain, and Nuada in Ireland. The cult of St. Catherine, not known in England before the Norman Conquest, is believed to have arisen in sites sacred to her predecessor, the olden Gaulish deity.

At a recent meeting of the Prehistoric Society of East Anglia, Mr. J. Reid Moir announced the discovery of a flint workshop floor in Ivry Street, St. Albans. An excavation for building purposes disclosed one foot of surface soil and two feet of fine stoneless sand. Then came the prehistoric stratum, containing flint cores and flakes, calcined flints, fragments of pottery, quartzite pebbles used as hammer-stones, and animal bones, some of which had been cut through, and, for some purpose, incised. Under this stratum lay fine sand to an unknown depth. Most of the flints were in the form of long flakes, patinated of a light blue colour. One had been trimmed for use as a scraper, and though it is difficult to attribute these specimens to any particular culture, Mr. Moir, judging from the length of the flakes, is inclined to assign them to the Magdalenian period. The bones found were those of a small sheep, teeth of an ox, and a tibia, probably that of a red deer. It is curious that another "find" of flints recently discovered at Ipswich is assigned to the Aurignacian period. If this attribution be accepted, we find remains of two Palæolithic periods within the confines of this town.

In *Meddelelser fra Kommissionen for Havundersogelser, Fiskeri*, Bd. iv., we have two papers dealing with the biology of the plaice. The first of these is by Dr. A. C. Johansen, on the immigration of plaice to the coastal grounds and fiords on the west coast of Jutland, and contains some interesting data on the changes in frequency of young plaice from one year to another in the shore zone. The second paper is by B. Saemundsson, on marking experiments carried out in the neighbourhood of Iceland. These experiments yield some results of interest, though they are not altogether satisfactory on account of the small numbers of fish dealt with. It is interesting to note that by far the largest number of recaptures were made by English trawlers from Grimsby and Hull. In the same volume there is a useful report by P. L. Kramp on fish-eggs and larvæ collected in 1909 in the Langelands Belt.

In the March number of the *Journal of Economic Biology* (of which we notice that Mr. W. E. Collinge is now sole editor) Mr. A. A. Girault, of the University of Illinois, completes his "Preliminary Studies on the Biology of the Bed-bug (*Cimex lectularius*)," giving details of successive pairings and generations with statistics as to the periods of feeding and the numbers of eggs laid by the females under observation. In summarising the reactions of bed-bugs to various stimuli, Mr. Girault states that the insect's usual behaviour of shunning light may be abandoned under the stronger stimulus of hunger. "Bed-bugs will visit a host in daylight or in bright artificial lights when hungry . . . as soon as the food-stimulus is neutralised by engorgement, however, the negativeness to light becomes dominant again, and the insect runs off to hide itself."

The February issue of the *Bulletin of Entomological Research* contains, as usual, systematic papers of considerable interest. Mr. F. V. Theobald writes on African Aphididæ, and is able to record "only thirty-five species for the whole African continent, about the number one can collect in a single afternoon in one's own garden in England," and several of these have clearly been introduced with nursery stock from Europe. Prof. R. Newstead describes new Coccidæ, and Mr. E. E. Austen new Tabanidæ, both papers being well illustrated. Of considerable interest is Mr. R. B. Woosnam's report on a search for Glossina (Tsetse-flies) on the Amala River in the southern Masai Reserve, of which he is game-warden. In a definitely restricted area along the river and its tributaries at more than 5000 ft. altitude he found a Western species, *G. fusca*, hitherto unknown in the East African Protectorate. The cattle, sheep, and goats of the Masai suffer very little from tsetse-borne disease, either because the people manage to avoid the fly-belt when moving their stock, or because only a very small proportion of the flies are infective.

By publishing reports for two successive years in a single cover, the Felsted School Scientific Society is enabled to reproduce some of the prize photographs taken by its members, the report for 1912–13 consequently presenting a more than usually attractive appearance. Particular interest attaches to the photographs of a young cuckoo and its foster-parent, a whitethroat.

In the newly issued vol. xxxiv. of "Botanisk Tidsskrift," Copenhagen, Ø. Winge gives an account of some new Sagasso Sea investigations. During 1911–13, the Danish Commission for the Study of the Sea organised a collection of plankton samples by Danish Transatlantic vessels. This material is now to be worked up, and Winge, who is studying the distribution and frequency of the Sargasso, finds the Gulf-weed consists chiefly of two species (*S. bacciferum* and *S. vulgare*), besides other less common forms (*Sargassum* species and *Ascophyllum nodosum*). The great quantity of Sargasso was met with between lat. 37° and 23° N., and long. 35° to 60° W., within an oval area about 600 miles broad. As was the case with the earlier "Sargasso-frequencies" of Krümmel and Antze, all the samples show an autumnal simultaneous increase of the quantity of the Sargasso. This suggests that the floating Gulf-weed has a long-lasting drift and a yearly growth-period in the late summer. Sexual reproduction of the drifting Sargasso is still unknown.

P. D. Quensel adds very greatly to our knowledge of the geology of western Patagonia in his "Geologisch-petrographische Studien in der patagonischen Cordillera" (Bull. Geol. Inst. Univ. of Upsala, vol. xi., p. 1). The great group of laccolitic intrusions, varying from granite to gabbro, is younger than the Cretaceous period, and even cuts the folded structure of the chain. As the photographs of scenery show, frost-action produces superb crags and pinnacles in these young and well-jointed granitoid rocks.

British geologists may be both surprised and gratified to find an elaborate paper in English on the geological structure and history of the Falkland Islands, by Thore G. Halle, in the Bulletin of the Geological Institution of the University of Upsala (vol. xi., pp. 115–226), accompanied by numerous illustrations and a coloured map. The feature of cardinal importance is the discovery of Permo-Carboniferous strata, with Glossopteris, and a glacial boulder-bed ("tillite") at the base. For this series the author proposes the local name Lafonian. The Permo-Carboniferous glaciation is thus seen to have a very wide extension, and it is interestingly pointed out that a laminated clay, and the occurrence of annual rings in the Dadoxyla of the local Gondwana flora, indicate a solar control of the climate during cold conditions. The laminated clay is figured, and bears a remarkable resemblance to those associated with the pre-Cambrian glacial beds in Ontario and with post-Pliocene glacial beds in Sweden.

A full report of the recent Sakura-jima eruption has been issued in Japanese by the Kagoshima Meteorological Station; it is especially interesting as giving accurate records of the events which preceded and followed the great eruption. The actual eruption commenced on the morning of January 12, but earthquakes, gradually increasing in intensity and frequency, were felt from early morning on January 11. The general features of the eruption have been already described, but we have now further particulars concerning the lava-flow. On January 14, at 7 a.m., a lava-stream was seen issuing from the mountain, but, encountering high ground, it spread out to a width of a mile and a half, with a thickness of "some scores of feet"; the flow of lava was resumed on the following day, several small craters being opened along its course, and on January 16 the lava-current reached the sea, pushing its way out to one of the small islands in the bay. The activity of the volcano gradually diminished from this time, but did not entirely cease until January 27. The earthquake shocks, which became less violent during the eruption, increased in number and intensity as the volcanic action declined, and then gradually died away. The seismometer recorded no fewer than 418 shocks on the day before the eruption, but during the eruption the seismometer having been broken, it was difficult to distinguish between earth-vibrations and the volcanic rumblings.

The Royal Meteorological Institute of the Netherlands has published the third quarter (December-February) of a new edition of its very laborious work, "Oceanographic and Meteorological Observations in the Indian Ocean." It consists of two parts: (1) tabular results for the years 1856–1910, and (2) charts constructed therefrom. This issue is much more complete than that for the previous quarter, owing to the inclusion (1) of observations for a longer period, and (2) of a large amount of data received from other meteorological services. In this latter respect special thanks are accorded to our own Meteorological Office. These additions, referring partly to routes not usually taken by Dutch vessels, have allowed certain areas to be more fully represented. The charts, twenty-five in number, show the frequency of direction and mean velocity of currents and winds, together with the general circulation of air and water for each of the months in question, isobars, isotherms, etc. On the backs of some of the charts details likely to be of use to seamen, and based upon all available data, have been carefully prepared. Taking into account the possible establishment of a direct service between the Netherlands' East Indies and South Africa routes are laid down for vessels between those parts, in addition to the tracks recommended for other places on either side of the Indian Ocean.

The shape of a nearly spherical drop falling in a viscous liquid of different density forms the subject of a paper by Shizumi Saito in the Science Reports of the Tokyo Imperial University, vol. ii., No. 5. The solution is obtained by harmonic analysis, though the method could be shortened by employing the ordinary polar equations of motion or Stokes's stream function. The paper leads to the conclusion that the drop may be deformed into a prolate or oblate spheroid, the distinguishing criterion being in the form of a relation connecting the densities and viscosities of the inner and outer liquids.

A valuable report on the effect of ice on the flow of streams in the United States has been drawn up by Mr. W. G. Hoyt, and forms Water Supply Paper 337 of the U.S. Geological Survey. The first report on the subject was issued in 1907, and dealt mainly with the field operations necessary for the estimation of the rate of flow. The present paper goes much further, owing to the work which has been done in the interval, and includes a discussion of the factors which influence the flow during the low-temperature period, and the calculation of the flow from the observations taken.

The Journal of the Washington Academy of Sciences for March 19 contains a *résumé* of a paper on the brightness of optical images by Mr. P. G. Nutting, which is to be published *in extenso* elsewhere. The results obtained deal principally with the transmitting power of various types of photographic lenses. The method adopted consists in exposing a white magnesia block to a luminous source of 1500 candle-power enclosed in opal glass, and comparing the brightness of the magnesia when illuminated direct, with the brightness of the image of the source when thrown on the same surface by the lens system under test. The observed transmissions vary from 57 per cent. for a Zeiss-Krauss tessar to 92 per cent. for a Fuess telescope objective. For several process lenses the transmission is 76–78 per cent., showing that for the six glass-air surfaces of which they consist the transmission is quite up to that theoretically obtainable.

It is interesting to read in the *Revue Générale des Sciences* (March 15) an elementary discussion of the principle of relativity by Prof. H. A. Lorentz, to whom, more than to any other, the hypothesis owes its origin. After a very clear exposition of some simple ideal experiments which illustrate the relative nature of the measures of space and time, he dismisses in a single paragraph what is to most physicists the greatest objection to the principle, the apparent denial of the existence of the æther as they had come to think of it. "That is, as it seems to me, a question towards which each physicist may take the attitude which best agrees with the way of thinking to which he is best accustomed." ". . . he must recognise that it is impossible for him to know the direction and the velocity of the æther (relative to his apparatus), and, if he feels the need of not concerning himself with his ignorance, he will take the side of M. Einstein." It is interesting to speculate how far it is possible to use these words and at the same time to feel convinced of the objective existence of a unique æther, which is something more than a convenient way of correlating phenomena, but may be described in Prof. Lorentz's own words as "always remaining at rest," and "endowed with a certain degree of substantiality."

In the *Monist* (vol. xxiv., No 1) Mr. Leonard T. Troland, under the title "The Chemical Origin and Regulation of Life," combats recent views on vitalism, that "cult of incompetence" in biology. The position taken up is that "a single physico-chemical conception may be employed in the rational explanation of the very life phenomena which the neo-vitalists regard as inexplicable on any but mystical grounds. This conception is that of the enzyme or organic catalyst." The thesis is developed along five distinct lines, the author maintaining that this conception will ultimately prove adequate to resolve such fundamental mysteries as the origin of living matter, the origin of organic variation, the problems of heredity, the mechanism of individual development, and the nature of physiological regulation in the mature organism.

An important method for the rapid estimation of zinc in coinage bronze and similar alloys is described by Dr. T. K. Rose, Assayer to the Mint, in a paper read before the Society of Chemical Industry (vol. xxxiii., No. 4). In this method the zinc is volatilised away by heating one gram of the alloy in a carbon crucible for two hours at a temperature of about 1375° C. Strictly speaking, this is not an entirely new method in principle, having been described many years back, but it is a process that has never come into general use. Dr. Rose has now made the method a perfectly practical one by accurately defining the conditions which are necessary for success. The main advantage of the method lies in the great saving of time and the avoidance of troublesome chemical manipulations.

The use of catalysis in organic syntheses has come into increasing use in recent years. In the current number of the *Comptes rendus* (No. 14, April 6) additional details are given by MM. Paul Sabatier and A. Mailhe on the advantages of manganous oxide as a catalytic agent in the synthesis of aldehydes and ketones. A fatty acid mixed with an excess of formic acid passed over a column of manganous oxide at a temperature of 300° C. to 360° C. gives the aldehyde corresponding to the acid, the yields being from 50–70 per cent. of the theoretical. The authors describe the preparation by this method of six aldehydes. With the same reagent adipic acid gives *cyclo*pentanone in 80 per cent. yield, and β-methyladipic acid gives β-methyl*cyclo*pentanone. Manganous oxide is cheap, and preserves its catalytic properties over a long period.

Oil-seeds, oils, fats, and waxes are the subjects dealt with in a recently issued collection of "Selected Reports" from the Scientific and Technical Department of the Imperial Institute (No. 88, Colonial Reports—Miscellaneous, Cd. 7260). The publication includes all the more important reports on the above-mentioned products made to the Colonial, Indian, and other Governments during the years 1903 to 1912. A large number of seeds and oils have been analysed and otherwise tested by the department, the object in view being to give information as to the yield and nature of the oil obtainable from the seeds, and the possibility of utilising the products commercially. The reports proper are preceded by a short introduction explaining the classification of the oils into groups, and the meaning of the analytical terms employed in the descriptions. Among the more interesting memoirs is one on the utilisation of para rubber seed, which contains a drying oil possessing properties very similar to those of linseed oil; it is concluded that the kernel is a valuable economic product. One of the longest reports treats of the palm-oil industry in British West Africa. Large areas of oil-palm forest still exist almost untouched, and though the native processes for extracting the oil are crude and wasteful, it is considered that no failure of supply is likely to occur in the immediate future.

The April issue of Mr. C. Baker's list of "Second-hand Instruments for Sale or Hire" is now available, and can be obtained post free on application to 244 High Holborn, London. The catalogue contains descriptions of nearly 2000 pieces of scientific apparatus, amongst which modern microscopes and objectives, telescopes and spectroscopes, take a prominent place. The preface to the catalogue points out that every instrument is guaranteed to be in adjustment, and that customers may in certain circumstances have instruments for three days on approval.

Messrs. Dulau and Co., Ltd., 37 Soho Square, London, W., have just issued their Catalogue 65 dealing with works on recent and fossil ichthyology which they are offering for sale. The list contains 1740 entries, and includes periodicals as well as books on every branch of the science concerned.

OUR ASTRONOMICAL COLUMN.

April Shooting Stars.—Mr. W. F. Denning writes:—On Tuesday night, April 21, there may occur a rich return of the April meteoric shower. It is uncertain, however, what this year's aspect of the display will be, as the periodic time is not known. There were brilliant returns in 1803 and 1851, and there is indication that the brighter and more abundant exhibitions of this stream occur at intervals of sixteen years. If so, it ought to be well seen in 1915, but in view of the doubts remaining, the phenomenon should be watched every year, for negative evidence is sometimes useful. The Lyrids probably form a moving radiant like the Perseids, the motion being to the eastward one degree a day. This feature should be attentively looked for, but the shower is usually a very brief one, and meteors directed from it are rarely seen before April 19 or after April 22. This year the moonlight will be almost absent from the sky at the time of the maximum, so that with a clear atmosphere the circumstances will be highly favourable for its observation.

Nova Geminorum No. 2.—A number of observations has recently come to enrich the general store of data regarding this nova, and some of these later contributions possess a high degree of importance. This applies especially to a memoir appearing in Bulletin No. 3 of the Imperial Academy of Sciences, St. Petersburg, communicated by M. N. V. Vojtkevič-Poliakova, of the Pulkova Observatory. Unfortunately for English students this memoir is printed in Russian, but it contains an excellent plate giving reproductions of eight spectrograms of the new star. It is at once apparent that evidence has been obtained regarding the transient proemial phase during which the nova exhibited a dark-line spectrum showing characteristics resembling that of Procyon. Although the Harvard spectrograms had established beyond any possibility of doubt that this nova had indeed passed through this so much questioned stage, the value of independent confirmatory evidence need not be insisted on. The series of thirty-six spectrograms discussed in the paper extends from March 15, 1912, to October 8, 1913, and includes two excellent plates taken on the first date, and others for March 16, 17, and 18. The wholly dark-line stage so happily caught at the Harvard College Observatory was missed at Pulkova, but the leading Procyonian features are still predominant in the first two spectra, although the bright-line spectrum is making its appearance, and on March 16 predominates, but the H and K lines may still be seen quite plainly.

Another spectroscopic paper comes from the Catania Observatory, and is the work of Dr. Vittorio Fontana. It appeared in the Memoirs of the Società Spettroscopisti Italiani, vol. ii., series 2, pp. 201–10.

Additional observations of the light changes of this nova are given in two papers published in No. 4720, *Astronomische Nachrichten.* In the first of these von J. Kasansky, Moscow Observatory, presents fifty-seven determinations, ranging from the time of the discovery (March 14, 1912) to March 27, 1913. The observed magnitudes range from 3·58 (H.R.) on the former to 8·76 on the latter date. By March 16 the brightness of the nova had fallen nearly two magnitudes to 5·54. The magnitudes for the greater part of the series are also stated in terms of the Potsdam scale, and can thus be at once compared with the values given in the other paper, which is by Sig. Eugeni Guerrieri, Capodimento Observatory. This series includes 139 determinations of magnitude between March 28, 1912, and April 29, 1913. The light curve exhibits the typical characteristics of nova variability. For the few common dates the two series show good agreement.

Diurnal Variations of Latitude.—During last year M. Jean Boccardi, in discussing the results of his observations for latitude made by the method of Struve, drew the conclusion that an effect of lunar attraction was suggested by displacements from the vertical. As these displacements were considerably greater than those which he could calculate by theory he was led to conclude that these latitude variations were caused by geological conditions special to the place of observation. Having subsequently become acquainted with M. Schumann's researches on latitude variations in which he could trace undulatory curves showing diurnal variations of latitude, M. Boccardi has completed some diagrams showing the march of the latitude values. These diagrams are not published in the communication which he sends to the *Comptes rendus* of the Paris Academy of Sciences (February 9, 1914, No. 6); tables only are given, but he states that the maxima and minima values of the latitude obtained with the four stars which he has observed follow one another at intervals which correspond to the movement made by the moon in right ascension during the corresponding intervals of right ascensions between the stars. Thus the action of the moon seems to be demonstrated.

A Perpetual Calendar.—We have received a neat perpetual calendar, "Alle Jahreskalender auf einem Blatt," by "Dr. Doliarius," of Leipzig (B. G. Teubner). It is of postcard size, and seems well adapted to the requirements of clergymen and others. Three tables are given: (1) the dates of Easter according to the Gregorian calendar, 1582–2000; (2) the corresponding Julian dates, 1470–2004; and (3) a double enumeration of the days of the year arranged in thirteen columns in such a way that any seven consecutive columns are complete in themselves. A separate card frame is supplied having a slit which fits over the width of seven columns, and as the top of the slit is marked with the seven days of the week an annual calendar is displayed when the frame is placed over table (3). The correct position of the frame is determined by a marked space which is adjusted to the date of Easter for the year required according to the indication of table (1) or (2). The manipulation of the calendar is quite simple, and furnishes the dates of the principal church festivals very readily.

PRIMARY EDUCATION AND BEYOND.

THE national system of education adumbrated by Lord Haldane and other responsible authorities about a year ago has not yet taken shape, but meanwhile a measure embodying some of the prospective reforms in the domain of elementary education has passed its second reading in the House of Commons. We refer to the Children (Employment and School Attendance) Bill introduced by the Hon. R. D. Denman, member for Carlisle. The principal changes in the law proposed by this Bill are the grant of optional powers to local education authorities to extend the age of leaving school from fourteen years to fifteen; no exception from school attendance to be allowed for children under thirteen years; the abolition of the existing half-time system; the grant to local education authorities of power to require attendance at continuation classes; and the prohibition of street trading by boys under fifteen and girls under eighteen.

While we await the complete scheme of national education promised by the Government, it may be worth while to state the present position as regards those points of primary education for which provision is made in Mr. Denman's Bill, particularly in the matter of continuation classes, which is likely to be given much attention in the near future. Mr. Pease, the President of the Board of Education, has recently made a personal examination of the continuation-school systems in France and Germany; and we may expect to hear something of his impressions and conclusions when he makes his next statement to Parliament upon the work and outlook of his Board.

As the law stands in England at present, a child can leave school immediately it reaches the age of fourteen years, whatever its position in the school may be. Partial exemption from school in order to enter employment during certain hours of the day can be obtained at the age of twelve years, or at eleven in agricultural districts, if the standard of exemption fixed by the local education authority has been passed. This is the "half-time system"; and since the year 1907–8 there has been a continued decrease in the number of children who have taken advantage of it; or rather of whom parents and employers have taken advantage by exploiting their labour. The latest report of the Board of Education (Cd. 6707) shows that there are about 70,000 half-timers, and that nearly 59,000 of these belong to the districts of Lancashire and Yorkshire engaged in textile industries. As about half a million children normally leave the elementary school every year, it is surely not much to insist that the seventy thousand partial exemption pupils should be compelled to remain like the rest until they have reached at least the age of thirteen years. If the age of compulsory attendance at school of all children were raised to fourteen years, the nation would benefit by the enaction of such a law.

But whatever may be the leaving age of the elementary-school career, the work and influence of the school are rendered largely nugatory unless the pupil passes at once into a system of continuation classes. In the "unguarded years" which follow elementary-school life, almost all that has been learnt is forgotten, and when later the thoughtful youth awakes to a sense of his deficiencies, he has to pick up in evening classes the threads carelessly thrown down a few years before. The voluntary attendance at evening classes in technical and other schools is a measure of the desire for further education among youths and girls who are arriving at years of discretion. The adult who, after a day's work in the workshop or office, devotes several hours a week to classes and preparation throughout a session shows by this very act that he has the spirit of perseverance and industry which leads to success. The number of such students is large—about 700,000—but when it is critically examined and compared with what it might be, the result is disappointing. After the first month or so of a session, when the novelty has worn off, there is a steady fall in the attendance at evening classes; and about 18 per cent. of the 700,000 students at the beginning fail to complete the small minimum of attendances—not more than fourteen hours—required in order to enable State grants to be paid toward their instruction. The average number of hours of instruction received by all enrolled evening students in the English county boroughs (including London) is fifty-eight, this number being about the same as that of the working periods in two weeks of ordinary school life. It is evident, therefore, that very many of the students who enter evening classes are not likely to receive instruction of any substantial value.

The great bulk of the work done in evening classes is of the continuation-school type; and it is with the juvenile students attending such classes that we are now particularly concerned. Nearly one-half of the students are under seventeen years of age, and this number—roughly 300,000—represents the position of continuation classes in England. The Board of Education estimates that the juvenile students attending evening classes do not make up more than 13 per cent. of the population between the ages of fourteen and seventeen, after making allowance for those still at elementary and secondary schools. The failure of the classes to attract anything like a sufficient proportion of the possible students is regretfully recognised by the Board as "one of the weakest links in the educational system of the country."

The voluntary system of continuation classes breaks down just when it is most needed. It is essential that children should attend such classes immediately upon leaving the day school, and not after several years' interval, as is usually the case at present. On account of this break of continuity, many evening classes are for adults who have forgotten their early schooling, and have to begin again with elementary subjects at a time when they want to take up technical studies with the view of advancement or of increased efficiency in their respective vocations. If most of the 223,000 students above twenty-one years of age attending evening classes had received suitable continuation education after leaving the elementary school, they would be capable of much higher work than is possible at present. The commonest complaint of teachers in technical institutes is that the students lack the basis of elementary knowledge upon which advanced technical instruction can be built; and the defect is largely due to the absence of a system of compulsory attendance at continuation classes. A few years ago the City and Guilds of London Institute, in conjunction with the Board of Education, took active steps to encourage the attendance of young persons engaged in different trades at evening continuation classes, with the view of their acquiring a competent knowledge of English, arithmetic, drawing, and elementary science before entering upon their first year's course of training in technology. Notwithstanding the establishment of group courses, and an increased grant for the attendance of students at evening continuation classes, it has not been found possible to insist upon evidence of attendance at such classes prior to the admission of students to a technical school. We have well-equipped technical institutes and colleges with teachers capable of giving instruction in the highest branches of specialised education, but most of the adult evening students, though familiar with the practice of their particular trades, are unable to take advantage of the instruction offered because they have forgotten what they learnt at school.

Advance in technical education properly so called is thus connected very closely with the problem of continuation classes; and the only satisfactory way of solving the problem is by a system of compulsory attendance at such classes from the time a boy or girl leaves the elementary school up to seventeen or eighteen years of age. The main difficulties are to decide when the classes should be attended, and to devise the means of enforcing attendance. Ought the hours of attendance to be in the day and within the number of hours of employment of young persons, or ought they to be taken out of the juvenile's own leisure time after the day's work is done? Some large firms make it a condition of employment of their apprentices that continuation classes should be attended for a specified number of hours weekly, but unless facilities are given for such attendance the objection can be made that the firms are increasing the number of working hours sanctioned by Acts of Parliament. It is not surprising, therefore, that trades unions have come into conflict with this system. Assembled representatives of labour, and of teachers, have on several occasions expressed their conviction that attendance at continuation classes should be counted as working hours under the Acts of Parliament limiting the hours of juvenile labour weekly. Only the most enlightened employers will be prepared to accept these conditions of continuation classes for the young persons in their employ, so that even when the principle of compulsory attendance is accepted the actual establishment of it in practice presents real difficulties.

Probably the most adaptable plan will be found in a modification of the system which has worked successfully in H.M. Dockyard Schools for many years. Apprentices in the dockyards have to attend school for twelve hours a week (two afternoons and three evenings). The Admiralty gives the apprentices seven and a half of these hours, and pays for this time as if it were spent in the workshop; the remaining periods have to be taken from the boys' own free time. Both employer and apprentice have thus to make some sacrifice; and the plan may well be taken as a model upon which a compulsory continuation-school system could be constructed.

This principle is embodied in the recommendations as to continuation schools drawn up by the education committee of the British Science Guild, and adopted at the last annual meeting of the guild. The recommendations represent the most practical scheme with which we are acquainted, and they are, therefore, here given in full:—

(1) Local education authorities should be required to make provision for the attendance up to seventeen years of age at suitably equipped continuation schools of all young persons above the age of fourteen years within their respective areas who are not otherwise receiving suitable education. In these schools, particular attention should be given to the continuance of manual and physical training commenced in the elementary schools, together with instruction having some relation to the occupations of the pupils.

(2) Employers should cooperate with local education authorities with the view of securing the attendance at continuation schools for at least six hours weekly during forty weeks a year of all young persons in their regular employment under seventeen years of age. As a practicable means of ensuring such attendance, it is suggested that the following conditions should be observed:—

(i) It should be illegal to employ any young person under seventeen years of age who is not in regular attendance at continuation classes for at least six hours weekly unless reasonable cause for absence be assigned.

(ii) In order to avoid undue strain upon young persons, after working the usual hours during the day, employers should grant them at least three hours a week out of the ordinary working hours for the purpose of attendance at continuation classes. It would, however, be most desirable where possible for employers to grant the whole six hours during the working day. Many young people would undoubtedly add evening hours of attendance, actuated by the desire for self-improvement.

(iii) The education authority should notify employers of any young persons in their employment who are not attending day or evening continuation classes for at least six hours weekly, in order that the employers may take the necessary steps to ensure attendance at such classes.

This scheme may not satisfy all the demands of extreme advocates of compulsory continuation schools, but it has the merit of reasonableness on its side, and its enforcement is well within the range of practical politics. It approaches the standard of requirement of continuation schools in many parts of Germany, where laws have been passed, and are in active operation, for the compulsory attendance for about 240 hours per annum, or six to eight hours a week, of all children who have left school, and until they are seventeen years of age, chiefly in day continuation schools, and within the hours normally devoted to labour; and its adoption would help to bring us in line with progressive educational movements abroad.

The most complete system of continuation schools on the Continent is at Munich, where every boy not attending a secondary or other day school is compelled to attend continuation classes for eight or nine hours weekly, in the daytime, for three or four years following the termination of the elementary-school course at fourteen years of age. Munich has an average of 330 hours annually for the pupils under instruction in the continuation schools, under a system of compulsory attendance. In the county boroughs of England the average number of hours of instruction in the evening schools is only fifty-eight, and in the administrative counties forty-nine, while, as we have seen, 18 per cent. of the students receive less than fourteen hours' instruction in the year, and not more than 13 per cent. of the young people between the ages of fourteen and seventeen are in attendance at continuation classes. In county boroughs (including London) the attendance at continuation classes is about 18 per cent. of the available juvenile population, and in administrative counties not quite 10 per cent.; but the ratio varies greatly, being only 5 per cent. or less in seventy-one county boroughs and forty-nine county areas.

The success attained at Munich is due to the intimate connection between the teaching and the trade of the pupils; and the provision of workshops and laboratories for practical work as the centre of the entire organisation. The continuation schools are of two types—a highly organised kind for youths between the ages of fourteen and eighteen years during their apprenticeship, at which they receive instruction in specific relation to their trades, and a central school for girls at which three years' attendance is compulsory after the close of the primary-school career. For every trade in which there are thirty apprentices to attend continuation schools, special classes are provided; and there are at present fifty-six of these trade schools, as well as twelve general schools. It is in this direction, namely, that of close relation between the occupation of the pupil and the work of the continuation school, that advocates of compulsory continued education in England may hope to obtain the cooperation of employers. Our trade preparatory schools, which are attended by boys from twelve to fifteen years of age, who will afterwards be engaged in trade, represent roughly the type of school in which continuation classes can best be carried on.

It is useless to make continued education of primary-school pupils compulsory without the provision and adequate equipment of schools for practical instruction in close relationship with the occupations of the pupils. The schools should thus do something to relieve the monotony and extend the outlook of the young workman who, on account of the minute subdivision of manual labour, may spend his life upon one small detail of some product or process, and learn nothing beyond it. Industrial advance demands the production of intelligent and adaptable types of workmen; and practical continuation classes offer a means of training them which is impossible under modern conditions of manual work. Mr. J. C. Smail, organiser of trades schools for boys under the London County Council Education Committee, has recently studied in Germany the compulsory system of continued education for boys from fourteen to eighteen years of age; and we may appropriately give here a statement of the conclusions arrived at by him with regard to such schools, as they have a direct bearing upon the foregoing remarks, which were written before the report was published:—

(1) There has been, broadly speaking, a difference in ideals between Germany and Britain in the organisation of technical courses. Germany is aiming at benefiting the nation by training properly all the workers through definitely specialised courses. Britain has organised so that individuals may secure what they think best for their own advancement.

(2) The fundamental basis of any course of study for technical students must be their trade or employment. If this is recognised and acted on in the preliminary years from fourteen to eighteen there is little danger of work at more advanced stages, even if irregularly organised, being ineffective.

(3) Germany is aiming at making good citizens and has realised that a good citizen must be a good workman.

(4) Germany has come to believe that workshop training alone is insufficient to make a sound industrial nation; that it must be reinforced by adequate education specialised to trades.

(5) This specialised education must include specialised calculations, technology, drawing, and citizenship. Munich also believes in trade work in the compulsory schools, Berlin does not.

(6) Citizenship must be taught to enable the worker to recognise his individual position in the State, his position with respect to his employer and his fellow-workmen, his family and social duties, the relative position of his trade in his own country, and in the world's commerce and industry.

R. A. Gregory.

CYTOLOGICAL ASPECTS OF HEREDITY.

THE current number of the *Quarterly Journal of Microscopical Science* (vol. lix., part 4) will be of exceptional interest to students of heredity from the cytological point of view. Dr. L. Doncaster contributes a very useful review of the present state of the evidence with regard to the material basis of hereditary transmission and sex-determination, under the title, "Chromosomes, Heredity and Sex." He concludes that the arguments in favour of the view that Mendelian characters are determined by chromosomes, though very strong indirectly, are lacking in direct evidence. The direct evidence of a relation between chromosomes and sex-determination is much stronger, and various cases are discussed. The phenomena of sex-limited inheritance, now known to occur in various groups of the animal kingdom, taken in conjunction with this relation, afford strong support to the view that the chromosomes play a very important part in the transmission of Mendelian characters, although the part played by the cytoplasm must also be taken into account. With regard to sex-determination difficulties arise in connection with the fact that this has been shown in certain cases to be modifiable by environmental conditions, and it therefore seems probable that the sex chromosome is associated with a particular type of cell-metabolism, which in turn is responsible for sex-determination.

A very important contribution to the discussion is made by Dr. R. R. Gates and Miss Nesta Thomas in "A Cytological Study of Œnothera mut. lata and Œ. mut. semilata in Relation to Mutation." These authors find that in the "mutants" of the evening primrose known as "lata" and "semilata," fifteen chromosomes always occur instead of the normal fourteen. The peculiar characters of these mutants are thus shown to be associated with the presence of an extra chromosome, which they are believed to have acquired by the abnormal distribution of both chromosomes of one pair to the same daughter-nucleus in the reduction division, the actual occurrence of such abnormal distribution having previously been demonstrated by Dr. Gates. The authors maintain that mutations and Mendelian hybrids are not of the same nature but must be contrasted with one another, the former owing their origin to germinal changes (*e.g.* the presence of an extra chromosome), and the latter to recombinations of the parental characters. Dr. Gates adds a useful note on the meaning of the term "mutation," and the difference between "mutations" and "fluctuations."

THE CURRENTS IN BELLE ISLE STRAIT.[1]

THE behaviour of tidal streams and currents in Belle Isle Strait, described by Dr. Dawson, Superintendent of Tidal Surveys to the Canadian Government, in a number of reports, the latest of which are before us, affords an example of the manner in which the various elements in a complex current may be distinguished one from the other. As the same may apply to other straits where the conditions are similar it should, therefore, be of more than local interest. The current in the strait is primarily tidal in character, and under normal conditions it will turn regularly; the flood running westward, and the ebb eastward with equal velocity. When, however, the moon is in high declination the resulting diurnal inequality causes one flood and one ebb in the day to be twice as strong as the other; the difference being much greater than that between ordinary or average springs and neaps.

In addition to the tidal fluctuations, the water has a tendency to make through the strait in one direction more than the other, thus causing a continuous gain to eastward or westward, as the case may be. The overbalance in one direction which is superimposed upon the usual tide elements to which the term element of *dominant flow* is given, introduces complications, because larger in relation to the strength of the tidal streams, especially at neaps when weak. It may, in fact, be so strong as to reverse the ordinary tidal streams or prevent them from turning, although the fluctuation in velocity be well marked.

The dominant flow, it is stated, cannot be attributed to local wind, because wind would produce merely a surface drift, whereas the dominant flow is that of the whole body of the water. It is, however, apparently

[1] The Currents in the Gulf of St. Lawrence. By Dr. W. Bell Dawson. (Ottawa: Government Printing Bureau, 1913.)

due to meteorological causes affecting, it is suggested, changes in the Labrador current or in the volume of water passing into the Gulf of St. Lawrence, occasioned by the distribution of barometrical pressure. The highest tides have been found to occur with winds from between north-east or north-west, and the lowest with winds from west or south-west.

The probable direction of the dominant flow may be inferred from the general weather conditions of the region, and from the presence or absence of floating icebergs in the strait; there being, as a rule, icebergs in the offing of the strait. With a dominant westward flow, bergs afloat in the offing will drift into the strait, whereas with a dominant eastward flow the strait is free from floating bergs; for the icebergs near either shore are certain to be aground and are therefore no guide; they may have been there for weeks. Even in the middle of the strait a berg, if large enough, may ground.

Briefly, the best indications are as follow:—The strait being clear of floating bergs, the barometer moderately high and rising or high and steady, a dominant flow to eastward is probable. There being floating bergs in the strait, and a barometric depression passing southward, indicated by broken weather, a dominant flow to westward is probable; and after a gale from north or north-west certain. The temperature of the water as an indication cannot be relied on.

On the whole the westward flow probably predominates in May and June; and, although less pronounced, the eastward flow is the more frequent in summer; while from September onwards the flow is more to the westward than to the eastward.

As regards the velocity of the current, when the moon is at its maximum declination and there is no dominant flow; at spring tides the strong flood and ebb velocity is 2·27 nautical miles; the weak flood and ebb 0·72 mile. At neaps, strong flood and ebb, 1·04 miles; weak flood and ebb, 0·32 mile. The greatest rates of dominant flow, observed during two seasons, considered separately, were:—Westward average, 1·69 nautical miles running continuously, but fluctuating from 2·65 miles to 0·64 with flood and ebb; eastward average, 1·30 miles to 0·50 mile with ebb and flood.

Under combined conditions the highest velocities observed were:—Westward during flood period, 3·45 nautical miles; eastward during ebb, 2·83 miles.

SUPERSTITIONS RELATING TO WEATHER.

IN an interesting article in the February number of *Himmel und Erde*, Prof. G. Hellmann, director of the Berlin Meteorological Institute, discusses some of the widespread notions generally included in the above heading. At the same time, he points out that some theories long believed in, although afterwards proved to be false, cannot be classed among superstitions.

The subject is divided into three parts, but we can here only refer to a very few typical cases. (1) That relating to the character and causes of meteorological phenomena. This takes us back to mythological times when all the forces of nature were personified; even to-day Jupiter Pluvius is frequently spoken of. Many of the present-day ideas still savour of superstition, *e.g.* the occurrence of thunderbolts, the *return* of a thunderstorm at a later time of the same day, and the belief in equinoctial gales. With regard to the latter, the author refers the idea to Greek and Roman origin, as such storms are prevalent in the Mediterranean regions.

(2) The possibility of predicting weather for any period. Many old sayings have been handed down from father to son; while most of them are based on unsound conclusions, some of them are good, *e.g.* the strengthening cold with lengthening days, the coloration of morning and evening sky, etc. Of modern sayings, that relating to the "ice-saints" (May 11–13) has been attributed both to cosmical and terrestrial sources. Investigations have shown that cold periods in May may occur in any of the three decades (especially the second), but cannot be referred to any special days. The moon's influence is still believed in by millions of people, notwithstanding the proofs given to the contrary.

(3) The possibility of influencing the weather and of making any special kind. This idea extends back to earliest times, and is still prevalent in some parts. One of the principal objects was the warding off of hail- and thunder-storms. Modern hail-shooting has proved to be ineffectual, but it will in all probability return later on in another form. The practice of bell-ringing for the prevention of thunderstorms was at one time much favoured, and is still in vogue in a few alpine districts. The belief in the possibility of making weather is very old, but its origin cannot be exactly fixed. Unsuccessful attempts at rain-making have frequently been made in recent times, but Europe appears to have been practically free from this superstition.

Prof. Hellmann's researches relating to the early history of meteorological questions are always very instructive; in this article he points out that at times it is not easy to draw a sharp boundary line between knowledge, belief, and superstition.

THEORIES OF ORE-GENESIS.[1]

THE subject of ore-genesis is of the greatest importance to the mining engineer, for it is evident that every forecast of the continuity of an ore-body beyond the limits of the ore in sight must, if it is not to be entirely empirical, rest on some hypothesis as to origin. This field of inquiry has since the beginning of this, and during the latter half of the past century, riveted the attention of the best mining geologists in all parts of the world. In a comparatively small interval of time, our knowledge has advanced by leaps and bounds, and many important principles governing ore-deposition have been firmly established.

It was, however, preceded by a long period, which, although fertile in suggestion and hypothesis, was not one of real progress because, contrary to the Baconian principle, "Non fingendum aut cogitandum sed inveniendum quid natura faciat aut ferat," the theories advanced were not founded on ascertained facts.

Prior to the sixteenth century the metallic contents of ore-veins were supposed to have been determined by their orientation in regard to the planets; and Agricola (1494–1555) was the first to formulate a reasonable genetic theory. Reduced to its simplest terms, Agricola's view was that ore-channels (*canales*), formed by erosion, had been filled by metallic minerals deposited from solution. These solutions, or juices (*succi*), as Agricola terms them, were waters of meteoric origin which, under the influence of heat, had taken mineral matter into solution.

From the time of Agricola to the end of the eighteenth century the mines of Saxony produced nearly all the writers on vein-formation. Such were Rösler, Becher, Henckel, Hoffmann, Zimmermann, von Oppel, von Charpentier, and von Treba.

Becher and Henckel, who wrote in the beginning

[1] From the presidential address delivered at the Annual Meeting of the Institution of Mining and Metallurgy, on March 26, by Dr. F. H. Hatch.

of the eighteenth century, supposed the metallic constituents of veins to have been produced by the action on pre-existing stony and earthy matters of subterranean vapours arising from certain processes of "fermentation" in the bowels of the earth.

In 1749 Zimmermann put forward a hypothesis which clearly had in it the germ of the modern theory of metasomatism. He ascribed the origin of veins to a transformation of the rocks into metallic minerals and their accompanying vein-stones, along certain directions now marked by the course of the veins, the solvents that effected the alteration finding a path through innumerable small rents and other openings in the rocks.

But Zimmermann applied his theory indiscriminately to explain the origin of all veins, including those that, by common agreement, are now considered to have been formed by the filling of fissures without replacement. Von Treba, in supporting Zimmermann's view, insisted particularly on the far-reaching changes effected in rocks by circulating waters, especially when aided by heat. "I am persuaded," he wrote in 1785, "that there is constantly going on in our mountains a variety of transformations, compositions, and decompositions, which not only take place at present, but will continue to the end of time."

According to Gerhard, who wrote in 1781, waters circulating through the rocks adjacent to a vein become charged with certain of the metallic and earthy substances contained in them. Passing through the crevices and interstices of the rocks to the larger rents and fractures, they deposit their mineral burden in cavities which, when filled, become veins. It will be seen that Gerhard's hypothesis must be regarded as a precursor of the more modern theory of *lateral secretion.*

To von Oppel belongs the credit of having shown that mineral veins were largely the filling of fault-fissures, a principle which up to that time does not appear to have been clearly recognised.

At the end of the eighteenth century the mining world was dominated in all matters relating to ore-genesis by the famous Freiberg professor, Abraham Gottlieb Werner, who insisted that all veins, including those that we now term "intrusive dykes," had resulted from the filling of contraction-fissures open above and connected with the primeval universal ocean, which according to the Wernerian doctrine covered the globe and contained in solution all the necessary materials for the formation of its crust. These waters, descending into the fissures from above, deposited the vein minerals by chemical precipitation.

This Neptunist view was in the beginning of the nineteenth century attacked and finally overcome by Hutton and his Plutonist or Vulcanist school. Unfortunately, however, the Plutonists went to the other extreme, and would not allow even ore-veins to have any other than an igneous origin: "The materials," wrote Playfair, "which fill the mineral veins were melted by heat and forcibly injected into the clefts and fissures of the strata."

But Hutton's broad generalisation, even with the important modifications of Elie de Beaumont, Daubrée, and Durocher to the effect that many of the metallic ores had been deposited from vapours and solutions emanating from cooling igneous magmas, was soon discarded in favour of the deposition from waters of meteoric origin; and an animated discussion was maintained for half a century on the respective merits of the *descensionist, ascensionist* and *lateral secretionist* theories; or, in other words, whether the mineral burden of the circulating waters instrumental in vein-formation was derived from superficial rocks, from deep-seated sources, or from the wall-rocks of the veins themselves.

The chief supporters of the modified form of the ascension theory here alluded to, which must, of course, be distinguished from De Beaumont's *ascension by emanation,* were Stelzner and Posepný. They argued that the ground-water (originating by precipitation from the atmosphere) descends by capillarity through the interstices of the rocks to deep-seated regions, and thus acquires a high temperature and pressure, and, consequently, a vastly increased solvent power, whereby in its passage through the rocks it is enabled to take up certain of the mineral substances there disseminated in a minute form. At a certain depth the water moves laterally towards open conduits, on reaching which it ascends towards the surface, depositing its mineral burden in proportion to the decrease of temperature and pressure.

It has been seen that the theory of lateral secretion, or the derivation of the mineral contents of veins by an aqueous leaching of the country rock, was advanced in a crude form as early as 1781 by Gerhard; but it remained a mere hypothesis without the support of ascertained facts until the middle of the nineteenth century, when the chemical work of Bischof, Forchhammer, and Sandberger definitely established two important facts in support of the theory, namely:—(1) That the gangue of ore-veins varies in correspondence with the wall-rock; and (2) that the heavy metals occur in minute traces in certain of the igneous and sedimentary rocks constituting the "country" of ore-veins.

Sandberger's researches were specially directed to prove that the heavy metals (gold, silver, copper, lead, etc.) are contained in the common ferro-magnesian silicates (namely, the micas, hornblendes, and augites) of the igneous rocks; and having satisfied himself on this point he was led to extend his investigations to the sedimentary rocks, with the result that small quantities of the heavy metals were found in the sediments of all ages, and especially in the slates of the older systems. Whether, however, they are there present as constituents of sporadic fragments of ferro-magnesian silicates derived from igneous rocks, or as sulphides that were introduced during the secondary mineralisation connected with ore-deposition, was not satisfactorily settled by Sandberger's researches. The more recent work of Don, carried out on a great variety of material, tends to show that the ferro-magnesian silicates do not carry gold or silver in amounts determinable by chemical analysis. Where the rocks examined by him were found to contain these metals they were present as a constituent of sulphides, such as iron pyrites, pyrrhotite, mispickel, chalcopyrite, and galena, which in most cases are secondary introductions.

But long before this the inapplicability of lateral secretion as Sandberger conceived it had become apparent; and the theory became the subject of vigorous attack on the part of Stelzner and Posepný.

Lateral secretion, in a much more extended sense and in combination with the ascension theory, is advocated by Van Hise. Van Hise's view may be briefly summarised thus: the meteoric waters, after penetrating the surface, are widely scattered through the rocks in innumerable small openings as they travel downward to great depths in the earth's crust. With steadily increasing temperature and pressure they take up mineral matter. The downward movement ultimately develops a lateral component, by which the waters are carried to the larger openings. During this process, also, the waters continue to take material into solution. In the larger openings the waters ascend with decreasing temperature and pressure, and there the ores are deposited.

It will be seen that this view is a combination of the ascension and the lateral secretion theories, and presupposes the existence of a continuous sheet of water in circulation between the ground-water level and the lower limit of the "zone of fracture," no circulation being admittedly possible in the underlying "zone of flowage." The weak point in Van Hise's assumption of a "sea of underground water" lies in the fact that deep mines are usually found to be dry, the drainage being confined to the upper levels. This, for instance, is the experience in the copper mines of Lake Superior, in the gold mines of the Rand, and in those of Bendigo. Van Hise, in reply to this criticism, attributes this dry zone to the closing of the passages by cementation; but the restriction of the ground-water circulation is equally fatal to the meteoric derivation of deep-seated thermal springs and other phenomena connected with vulcanicity.

In recent years there has been a partial reaction to igneous views. Thus certain classes of ore-deposits are now held to have been formed by a *differentiation of igneous magmas* prior to consolidation. Such, for instance, is the origin ascribed to certain titaniferous iron-ores in basic eruptives, chromite in peridotites, nickeliferous pyrrhotite in norite, and primary platinum in ultra-basic rocks. Similarly pegmatites, and even some quartz-veins, are considered to have originated by the consolidation of the aqueo-siliceous residuum of a slowly cooling granite magma.

But more important in its application to ore-deposition than *magmatic differentiation* is the theory which Vogt has founded on the metalliferous emanation hypothesis, by which Elie de Beaumont and Daubrée sought to explain the origin of tin-ore deposits. According to the *pneumatolytic* theory, certain *agents minéralisateurs*, such as fluorine, chlorine, sulphur, phosphorus, silicon, and boron, have the property of forming with the metals volatile compounds, which escape from the granite-magma as gases with low critical temperatures (the *aura granitica* of Elie de Beaumont). These compounds ascend through already formed fissures in the overlying rocks, or force their own passage by attacking the minerals that compose them. In this manner, for instance, cassiterite, wolfram, tourmaline, fluorspar, topaz, beryl, axinite, datolite, apatite, etc., are deposited either in the granite itself, or in the sediments comprised within its metamorphic aureole.

Closely connected with pneumatolysis in the rôle ascribed in ore-deposition to the so-called *magmatic waters*, a term that has come into use for water not of atmospheric origin, but dissolved or occluded in some way in molten magmas, from which it separates by liquation and distillation on the fall of temperature and pressure. In it are concentrated the substances that (at the existing temperature) are more soluble in water than in the silicate magma.

Suess, in an address on the Karlsbad springs, delivered in 1902, directed attention to the connection existing between thermal springs, vulcanicity, and ore-deposition. He applied the term *hypogene* or *juvenile* to thermal springs (like those of Karlsbad) which, originating in the depths of the earth's crust, bring water to the surface for the first time. Such hot springs are, in fact, the last survivors of vulcanicity, being the relics of a late stage of fumarole activity. Their mineral content comprises readily soluble compounds of the alkalies and alkaline earths, together with, and partly in combination with, sulphur, chlorine, and carbon dioxide, the less soluble metallic compounds having already been deposited as ores at lower depths in the earth's crust. According to Suess the after-products of eruption vary with the temperature; in the earlier (pneumatolytic) *phases of emanation* the gases are dry and their deposits (such as tin-ore and its accompanying boron, fluorine, tungsten, and uranium minerals) are the products of sublimation. At a later period, strongly alkaline magmatic waters are given off, and to these are attributable the *sulphide* and *arsenide phases* of vein-formation, *e.g.* the deposition of iron pyrites, chalcopyrite, primary bornite and chalcocite, enargite, galena, blende, etc.

But although, as we have seen, waters of meteoric origin have been displaced from their pride of place as agents of deposition for what we must term the primary sulphide ores, they are undoubtedly the formative agents for a considerable number of ore-deposits, including the products of oxidation, chlorination, and reduction above the permanent water level, and the secondarily enriched ores usually found immediately below the junction of the zone of oxidation with the zone of primary sulphides. So important are the functions of the vadose waters (to use Posepný's term for the shallow water circulation) in dissolving and redepositing at a lower level the ores of copper in a concentrated form, that it has been confidently stated that the bulk of the copper production of the world, not alone in the past, but also at the present time, is drawn from the zone of secondary enrichment. This view will, perhaps, appear exaggerated in the light of the results recently obtained by Sales at Butte; but for the majority of the great copper deposits of the world it may still pass unchallenged.

In the same way, vast deposits of high-grade iron-ore have been formed as the result of secondary enrichment, but under entirely different conditions from those that determine copper-ore enrichment. Thus the hæmatite ores of Lake Superior are believed by Van Hise to have been derived by the oxidising and concentrating action of vadose waers, from a low-grade cherty iron carbonate originally deposited under water as a chemical sediment; and he draws the important conclusion that "the ore-bodies cannot be expected to extend beyond the depth to which the descending waters may bear oxygen and precipitate iron oxide." He has "no doubt that vastly more high-grade iron-ore will be taken out in the Lake Superior region above the 1000-foot level than below it." If this be true, the iron-ores of that district, with more than 60 per cent. of metallic iron, are not inexhaustible.

The enrichment of gold-ores also takes place in the zone of oxidation; but in their case the action of the vadose waters results in an abstraction of the more soluble and less valuable metals, leaving behind a smaller quantity but a relatively richer material; in other words a diminution of the specific gravity of the whole material raises the gold tenor. Furthermore, there is also an increase in the fineness of the gold, due to the removal of a portion of the silver with which it is alloyed. The Mount Morgan mine in Queensland is a good instance of a gold-ore enrichment brought about by the vadose circulation; here the oxidation of a pyritic copper lode with subordinate gold has, by the removal of the sulphides of iron and copper, led to the formation of an upper zone of cellular quartz, in which the increased ratio of gold to vein-stuff was the *vera causa* of the richness of one of the premier gold mines of the world. But, as with increasing depth the mine-workings are extended below the oxidation-zone, the copper production is becoming more important than the gold yield.

The Witwatersrand Banket is another example. In this case the primary ore is auriferous iron pyrites disseminated in a quartz-conglomerate on which intense silicification during cementation has impressed the character of a quartz vein. The removal of the pyrites from the zone of oxidation, which extends to 200–300 ft. below the surface, left an enriched free-milling ore that gave marvellous returns on the amalgamation plates of the first Rand mills. Since the exhaustion of this high-grate, free-milling ore early in the history of gold mining on the Rand, the mines have been worked in low-grade unoxidised pyritic ore; and this has shown a gradual but steady impoverishment with increasing depth—a fact which supports the view that the gold of this deposit was precipitated by ascending thermal waters in proportion to their loss of temperature and pressure.

One of the most remarkable advances in the science of ore-genesis during the period under review is the recognition of the important rôle played by metasomatism in the formation of ore-bodies. The fact that the rocks adjacent to vein-fillings often contain small quantities of metallic ores similar to those composing the veins themselves, or are altered for some distance away from them, was observed at an early date; but its significance was very differently interpreted. The lateral secretionists pointed on one hand to ore-disseminations in the wall-rocks as indicating the source of the vein-filling, and on the other, to the

Classification of Ore-Deposits.

Nature of Deposit	Vehicle or Agent of Ore-Deposition					
	a. Molten Magmas	*b.* Gases and Vapours above their critical temperatures	*c.* Deep-seated waters, whether of magmatic or meteoric origin	*d.* Vadose Waters	*e.* Mechanical Agents such as moving water and wind	*f.* Chemical and Bacterial Agents in seas, lakes and swamps
1. IGNEOUS DIFFERENTIATES.	*Certain Massive Iron and Nickel Ores associated with basic igneous intrusions* (*e.g.* those of Sudbury in Ontario).					
2. CAVITY-FILLINGS.	*Injected Tin-Ores* (*e.g.* tin-pegmatites and tin-elvans on the margin of granite intrusions.	*Pneumatolytic Cavity-fillings* (*e.g.* tin quartz veins).	*Hydato-genetic Cavity-fillings* (many fissure veins).	*Superficial Fracture-fillings*, such as gash-veins in limestones and cavity-fillings (*e.g.* the hæmatite-ores of Cumberland).		
3. META-SOMATIC REPLACEMENTS.		*Pneumatolytic Replacements* (*e.g.* tin-greisens and many contact-deposits).	*Hydato-genetic Replacements.* (Many veins and massive deposits, also the Rand Banket).	*Some Lead and Zinc Ores* in *limestones. Iron-ores replacing limestones* (*e.g.* Cleveland). Some *lateritic iron* and *manganese deposits. Secondary enrichments of copper ores.*		
4. STRATIFIED DEPOSITS.			*Possibly some Sedimentary Deposits in which the cementing materials are ores of the metals.*	*Some Lead and Copper Ores interstitial in sandstones and shales.*	*Mechanical Concentrates in bedded deposits* (*e.g.* gold and platinum placers, stream-tin, iron-sands, detrital laterites and other metalliferous gravels and sands).	*Chemical and Bacterial Sediments* (*e.g.* lake- and bog-iron ores; clay-iron-stone and other sedimentary siderites; bog-manganese-ore and other sedimenttary manganese ores).
5. RESIDUAL DEPOSITS.				*Mantle-deposits* *e.g.* pisolitic and nodular ores of iron (Bilbao and Appalachian hæmatites and limonites of manganese (psilomelane) and of aluminium (bauxite).	*Eluvial Gravels formed near the outcrop of veins* (*e.g.* those of gold, cassiterite and wolfram, galena and zinc-ores).	

alteration of these rocks as a concomitant of the leaching that collected the filling material. But the ascensionists, whether belonging to the school of Elie de Beaumont and Durocher or to that of Stelzner and Posepný, recognised that the solutions from which the materials of the lode were precipitated, whether gaseous or liquid, also penetrated the walls and there caused certain deposits in the rock itself—metallic ores taking the place of some other mineral dissolved, as, for example, when cassiterite forms pseudomorphs after feldspar in the granite country of tin-veins. Much evidence favouring the latter view has since been accumulated. Thus Posepný described in 1873 the replacement of carbonate of calcium by carbonate of zinc in the Raibl deposits; and Pumpelly in the same year attributed the origin of the native copper of the famous Michigan deposits to metasomatic processes.

In 1881 Emmons showed that the Leadville silver-lead deposits had been formed by the replacement of limestone by galena, blende and pyrites, an alteration which, although chemically complete, left untouched the granular texture, joints, and other structural features of the original limestone. He pointed out that the resemblance of the altered rock to limestone was so perfect that, when the faces of the drifts were covered with dust, the observer was often completely deceived until the breaking of a fresh fragment with the hammer revealed the metallic gleam of galena beneath.

In a later paper he showed that many so-called fissure veins were not true cavity-fillings, but owed their origin to the metasomatic replacement of the rock material by substances brought in by solutions circulating along fault-fissures, through crush-zones or in sheeted zones. In such cases a vein may be formed by the replacement of the material enclosed between adjacent parallel fractures, true cavity-filling being only of a restricted character. Owing to the difference in character between replaced sheets of country rock and the filling of the fissures that divide them, deposits formed in this way sometimes possess a banded structure, which, however, is distinguishable from the normal "crustification" of vein-fillings. The whole subject has been admirably reviewed by Lindgren and by J. D. Irving in their well-known papers, in which will be found many illustrations of the potency of metasomatic processes in vein-formation.

Modern views on ore-genesis may be reduced to two principal lines of inquiry, one dealing with the agent or vehicle by which the metals have been collected, conveyed to, and deposited in the places where they are now found, and the other with the nature of the concentrates formed in the course of these processes.

Considering the latter first, ore-deposits are found to be either:—(1) Igneous differentiates; (2) cavity-fillings; (3) metasomatic replacements; (4) stratified or sedimentary deposits; (5) residual deposits. Of these, the sedimentary deposits comprise marine, lacustrine, and fluviatile accumulations, including placers.

Coming now to the agents or vehicles of ore-concentration, these are found to be:—(*a*) Molten magmas; (*b*) gases and vapours above their critical temperature; (*c*) deep-seated waters, whether of magmatic or of meteoric origin; (*d*) vadose waters; (*e*) chemical and bacterial agents in lakes and seas; (*f*) mechanical agents, such as moving water and wind.

It is possible, by combining the facts elicited by these two lines of inquiry, to formulate a genetic scheme of classification. For example, cavity-filling may be due to igneous injection, to gases and vapours above their critical temperatures, to deep-seated waters, or to vadose waters; again, metasomatic replacement may be brought about by gases and vapours, by deep-seated waters, or by vadose waters. By arranging these two series of relationships in vertical and horizontal columns respectively, all the various types of ore-deposits are obtained at their intersections; and in this way the classification shown in the table on p. 179 is obtained.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced in *Science* that provisions for the creation of a trust fund, said to be approximately 100,000*l.*, for the maintenance of male graduates of the Williamsport, Pa., high school at Cornell University are made by the will of Mr. A. D. Hermance. From the same source we learn that Mr. E. Palmer, a Princeton graduate, has offered to build and present to Princeton University a stadium costing 60,000*l.* Mr. Palmer is a son of the late Mr. Stephen S. Palmer, who was for many years a trustee of Princeton University, and gave large sums to the University, including the Palmer Physical Laboratory.

Many important recommendations are made in the report of the Royal Commission on the Civil Service just issued as a Blue-book (Cd. 7338). It is proposed to abolish the grades known as the Second Division, the Intermediate Class, the Assistant Clerks, and the Boy Clerks, and to substitute for them a new class, to be known as the Junior Clerical Class, to be recruited at the age of sixteen, at which many boys leave the public secondary schools. Another new class recommended is the Senior Clerical Class, to be recruited at the age of eighteen. In both cases the examinations for appointments in these grades are to be brought into close relation with the work of the schools. Other recommendations are:—(1) Greater facilities should be provided, especially in England and Ireland, for the progress from the primary to the secondary schools, and thence to the universities, of pupils capable of benefiting by secondary and university training respectively. (2) There should be closer coordination between the educational systems of the country and the Civil Service Examinations, and to this end the Treasury and the Civil Service Commissioners should consult more freely and systematically than hitherto with the Departments of Education before framing examination schemes. (3) The principle of open competition should be adhered to, and whenever it is applicable, extended. (4) The competitive examinations for recruiting each class of officer, administrative and clerical, should be adjusted in respect of the age of competitors and the subjects of competition to the stages of the educational system actually existing in the country. (5) The examinations should be directed to testing the natural ability of candidates, and the results of their education both with respect to acquirement of knowledge and the formation of mind and character. It should not be directed to testing proficiency in particular subjects which lie outside the normal scope of education.

SOCIETIES AND ACADEMIES.

London.

Linnean Society, April 2.—Dr. A. Smith Woodward, vice-president, in the chair.—W. **Rushton**: Structure of the wood of Himalayan Junipers.—W. B. **Turrill**: A contribution to the flora of Fiji.—Prof. C. **Chilton**: A new Amphipodan genus and species (family Dexaminidæ) from New Zealand.—Prof. E. B. **Poulton**: Mr. W. A. Lambourn's breeding experiments upon *Acraea encedon* (Linn.), Poulton, in the Lagos district of West Africa, 1910–12.

DUBLIN.

Royal Dublin Society, March 24.—Dr. J. H. Pollok in the chair.—Prof. John **Joly**: The local application of radium in therapeutics. The method now very often adopted in treating malignant growths with radium or its emanation is to introduce the radio-active substance, heavily screened with lead, into the tumour. This is a wasteful method, as the lead screen causes a loss by absorption of from 25–30 per cent. of the rays. The use of the screen is, however, necessary in order to cut off the more easily absorbed rays which otherwise would produce injurious effects close to the tube. If tubes containing much smaller quantities are used, screening need not be resorted to. One strongly charged tube may be replaced by a number of small ones, if the latter are in the convenient form of ordinary exploring needles. In conjunction with Dr. W. C. Stevenson the author has worked out a system enabling such needles to be charged with any required quantity of the emanation sealed into capillary glass tubes. By the use of these radio-active needles local injury is avoided, and a more controllable and uniform radiation is attainable. They can be made of any required length to reach more deep-seated tumours. An apparatus was exhibited permitting any desired number of capillary tubes to be sealed off at once, each containing a known charge.

PARIS.

Academy of Sciences, April 6.—M. P. Appell in the chair.—Paul **Sabatier** and A. **Mailhe**: The use of manganous oxide for the catalysis of acids. The preparation of aldehydes and pentamethylene ketones. Formation of the *cyclo*pentylamines (see p. 171).—R. de **Forcrand**: Potassium trioxide and the stability of the alkaline peroxides. Pure potassium trioxide can be obtained by heating the tetroxide to 580° C., the pressure being maintained at about 1 mm. The heats of solution and formation of the trioxide were determined.—G. **Charpy** and S. **Bonnerot**: Iron nitride. Iron in very thin foil, heated in a current of ammonia at 650–700° C., can be completely converted into the nitride Fe_2N. At higher temperatures the nitride dissociates, and it does not appear possible that this nitride could exist in the steel or iron of commerce.—A. **Schaumasse**: Observations of Kritzinger's comet (1914*a*) made at the Observatory of Nice. Positions are given for March 30, 31, and April 4.—Paul **Bruck**: The elements of comet 1914*a* (Kritzinger).—P. **Chofardet**: Observations and calculation of the parabolic elements of Kritzinger's comet (1914*a*) made at the Observatory of Besançon. Positions are given for March 31 and April 4.—J. **Guillaume**: Observations of Kritzinger's comet made at the Observatory of Lyons. Positions given for March 31 and April 4.—M. **Esmiol**: Observations of Kritzinger's comet made at the Observatory of Marseilles. Observation on April 4.—M. **Coggia**: Observations made at the Observatory of Marseilles on the same.—P. **Salet** and M. **Millochau**: The spectra of the chromosphere. The Stark effect due to the possible influence of the solar electric field is either absent or very small in the sun.—B. **Fessenkoff**: The distribution of the cosmic dust in the invariable plane of the solar system.—Arnaud **Denjoy**: Examples of derived functions.—A. **Buhl**: The integral form of the equations of Monge-Ampère.—A. **Hurwitz**: The critical forms of the inverse functions of integral functions.—Paul **Lévy**: The functions of Green and Neumann.—M. **Hadamard**: Remarks on the preceding paper.—G. H. **Hardy**: The zeros of the Riemann function $\zeta(s)$.—M. **Moulin**: The terminal curves of spirals: influence of the terms of the second order.—H. **Bourget**, Ch. **Fabry**, and H. **Buisson**: The atomic weight of nebulium and the temperature of the nebula of Orion. The strong double ultra-violet line $\lambda\lambda$ 3726, 3729, is attributable to no known gas. From a spectroscopic study by interference methods the atomic weight of the element, named nebulium, is found to be about 3. The temperature of the nebula is of the order of 15,000° C.—Maurice **Drecq**: The determination of the emissive power in the infra-red. Details of the construction of a very sensitive silver-bismuth thermocouple and of a new form of furnace for giving high black-body temperatures are given.—Jean **Bielecki** and Victor **Henri**: Contribution to the study of tautomerism. A quantitative study of the absorption of the ultra-violet rays by fatty diketones. The constitution admitted for the second tautomeric form of acetylacetone, $CH_3.CO.CH:C(OH).CH_3$, is incompatible with the absorption spectra. A more probable constitution is $CH_3.CO.CH_2.C(OH):CH_2$.—A. **Portevin**: The carbon equilibrium of steels in fused mixtures of potassium chloride and cyanide.—R. **Devisé**: The microsporocytes of Larix.—L. **Massol**: The effects of snake poisons on the coagulation of the serum of the horse by heating. Differentiation of the poisons of Viperideæ and Colubrideæ. The effects of cobra poison are consistent with the view that it contains two diastases with contrary actions, one retarding and the other accelerating the coagulation.—Mme. Victor **Henri**: Study of the metabiotic action of the ultra-violet rays. The production of forms of mutation of the anthrax bacillus. The exposure of spore-bearing anthrax bacilli to ultra-violet light causes profound changes in the organism. The surviving bacilli are transformed into new forms distinguished from normal anthrax bacilli by their morphological, biochemical, and biological characters.—Louis and Charles **Fortineau**: The treatment of anthrax by injections of sterilised pyocyanic cultures. An account of the treatment of nine cases of malignant œdema and forty-one of malignant pustule by subcutaneous injection of sterilised pyocyanic cultures: the mortality was reduced to 10 per cent.—Em. **Bourquelot** and Alexandru **Ludwig**: The biochemical synthesis of β-*ortho*methoxybenzylglucoside and of β-*meta*nitrobenzylglucoside. These syntheses were effected with the aid of emulsin in aqueous acetone solutions.—Adrien **Guébhard**: The tectonic in the neighbourhood of Castellane (Basses Alpes).—Sabba **Stefanescu**: The origin of the cuneiform sheets of the molars of elephants.—Henri **Bresson**: Eight hydrographical maps of the Normandy region.

BOOKS RECEIVED.

Australian Fossils. By F. Chapman. Pp. 341 + map. (Melbourne and London: G. Robertson and Co. Propy., Ltd.)

Canada. Department of Mines. Mines Branch. Annual Report on the Mineral Production of Canada during the Calendar Year 1912. Pp. 339. By J. McLeish. (Ottawa: Government Printing Bureau.)

Der Geist des Hellenentums in der modernen Physik. Antrittevorlesung gehalten am 17 Januar 1914 in der Aula der Universität Leipzig. By Prof. A. E. Haas. Pp. 32. (Leipzig: Veit and Co.) 1.20 marks.

An Account of the Crustacea of Norway. By G. O. Sars. Vol. vi., Copepoda. Parts 3 and 4, Cyclopidæ (continued.) (Bergen: The Bergen Museum.)

Simple Directions for the Determination of the Common Minerals and Rocks. By Prof. W. H. Hobbs. Pp. 31. (London: Macmillan and Co., Ltd.) 1*s*. net.

Botanische Jahrbucher. Fünfzigster Band. Supplement-Band. Fest-Band für A. Engler. Pp. 672 + xi plates. (Leipzig and Berlin: W. Engelmann.) 55 marks.

The South African Institute for Medical Research. Specific Serological Reactions with Pneumococci from

Different Sources. By F. S. Lister. Pp. 14+plate+charts. (Johannesburg.) 2s. 6d.

London County Council. Trade and Technical Education in France and Germany. Pp. 47. (London: P. S. King and Son.) 1s.

Physiological Plant Anatomy. By Prof. G. Haberlandt. Translated from the fourth German edition by M. Drummond. Pp. xv+777. (London: Macmillan and Co., Ltd.) 25s. net.

The Golden Bough. By Prof. J. G. Frazer. Third edition. Part iv. Adonis, Attis, Osiris. Vol. i. Pp. xvii+317. Vol. ii. Pp. x+321. (London: Macmillan and Co., Ltd.) Two vols., 20s. net.

Science and Method. By H. Poincaré. Translated by F. Maitland. Pp. 288. (London: T. Nelson and Sons.) 6s. net.

Board of Agriculture and Fisheries. Agricultural Statistics, 1913. Vol. xlviii. Part 1. Acreage and Live Stock Returns of England and Wales, with Summaries for the United Kingdom. Pp. 119. (London: H.M.S.O.: Wyman and Sons, Ltd.) 6d.

Defensive Ferments of the Animal Organism. By E. Abderhalden. Third enlarged edition. English translation by Dr. J. O. Gavronsky and W. F. Lanchester. Pp. xx+242. (London: J. Bale, Ltd.) 7s. 6d. net.

Ornamental Lathework for Amateurs. By C. H. C. Pp. 121+xxii plates. (London: P. Marshall and Co.) 3s. 6d. net.

Klimatographie von Kärnten. By Prof. V. Conrad. Pp. 139. (Vienna: Gerold and Co.)

Echinoderma of the Indian Museum. Part viii.

DIARY OF SOCIETIES.

THURSDAY, April 16.

Concrete Institute, at 7.30.—The Design of Steel and Reinforced Concrete Pillars with special reference to Secondary and Accidental Stresses; O. Faber.

Institution of Mining and Metallurgy, at 8.—Notes on Mine Survey Records and Calculations: C. G. Priest and W. Whyte.—Collecting and Handling Flue Dust: E. Huntley.—A Desciiption of a Portion of Equatorial Africa: H. W. Hill.

FRIDAY, April 17.

Malacological Society, at 8.—Notes on Australian Mactridæ: E. A. Smith.—On the Generic name Martensia, Semper: Some more notes on Polyplacophora. I.: T. Iredale.—Description of a new recent Pholadomya from Tasmania: C. Hedley and W. L. May.—Description of a New Helicoid from South Australia: G. K. Grude.

Junior Institution of Engineers, at 8.—A Few Typical Carburetters: R. S. Fox.

Association of Economic Biologists (at Royal College of Science), at 10 a.m.—The Organism of Common Potato Scab. (*Actinomyces scabies.* (Thaxter) Güssow): H. T. Güssow.—Potato Diseases: A. S. Horne.—Insects causing Blotch on Potato Foliage: A. S. Horne and H. M. Lefroy.—Standard Fungicides and Insecticides: A. G. L. Rogers.—Observations on *Aphis rumicis*: J. Davidson.—The Golf Green Fly: A. W. Westrop.—Observation on the Winter Stage of the American Gooseberry Mildew. (*Sphaerotheca mors-Uvae*): E. S. Salmon.—The Darkening of Oak: P. Groom.—The Phytopathological Conference: A. G. L. Rogers.—Apple and Pear Sucker: P. R. Awati.—An Experiment in House Fumigation: H. M. Lefroy.—Life-history and Habits of *Aleurodes vaporariorum*: E. Hargreaves.

SATURDAY, April 18.

Association of Economic Biologists, at 10 a.m. (*See Papers under April* 17.)

MONDAY, April 20.

Junior Institution of Engineers, at 8.—Lines of Future Development in High Power Diesel Oil Engines: J. Richardson.

Victoria Institute, at 4.30.—The Latest Discoveries in Babylonia: Dr. T. G. Pinches.

TUESDAY, April 21.

Royal Institution, at 3.—Problems of Physical Chemistry. I. Study of Matter at High Pressures: Dr. W. Wahl.

Royal Statistical Society, at 5.—Rural Population in England and Wales A Study of the Changes of Density, Occupations and Ages: Dr. A. L. Bowley.

Institution of Civil Engineers, at 8.—*Further Discussion:* The Transportation Problem in Canada, and Montreal Harbour: F. W. Cowie.

Zoological Society, at 8.30.—Further Contributions to the Anatomy of the Ophidia: Surg. I. C. Thompson.—Crustacea from the Falkland Islands Collected by Mr. Rupert Vallentin. II: Rev. T. R. R. Stebbing.—Report on the Arachnida and Myriopoda Collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: S. Hirst.—The Coloration of the African Hunting Dog (*Lycaon pictus*): Major J. Stevenson Hamilton.—Notes on *Aristeus goldiei*, Macleay, and on some other Fishes from New Guinea: C. Tate Regan.—The Courtship-habits of the Great Crested Grebe (*Podiceps cristatus*); with an Addition to the Theory of Sexual Selection: J. S. Huxley.

WEDNESDAY, April 22.

Royal Meteorological Society, at 7.30.—Report on the Phenological Observations for 1913: J. E. Clark and R. H. Hooker.—A Small Anemometer for Tropical Use: A. J. Bamford.

Faraday Society, at 8.—Recording Pyrometers: C. R. Darling.—The Embrittling of Iron by Caustic Soda: J. H. Andrew.—Diffusion and Membrane Potentials: Dr. E. B. R. Prideaux.—The Acidic and Colloidal Properties of Aluminium Hydroxide: Dr. R. E. Slade and W. G. Polack.—"Negative" Absorption: A. M. Williams.

THURSDAY, April 23.

Royal Geographical Society, at 5.—The East African Trough: J. Parkinson.

Child Study Society, at 7.30.—Raising the Standard of Child Upbringing Rev. J. C. Pringle.

Concrete Institute, at 7.30.—Sand and Coarse Material and Proportioning Concrete: J. A Davenport and Prof. S. W. Perrott.

Institution of Electrical Engineers, at 8.—Electrification of Railways as affected by Traffic Considerations: H. W. Firth.

FRIDAY, April 24.

Royal Institution, at 9.—The Stars around the North Pole: Dr. F. W. Dyson.

Junior Institution of Engineers, at 8.—A Visit to the Iron Districts of French Alsace: G. Evetts.

Institution of Mechanical Engineers, at 8.—Application of Electrical Driving to Existing Rolling Mills: L. Rothera.

SATURDAY, April 25.

Royal Institution, at 3.—Similarity of Motion in Fluids. I. The Theory of Similarity of Motion in Fluids and the Experimental Proof of its Existence: Dr. T. E. Stanton.

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THURSDAY, APRIL 23, 1914.

A TREATISE ON IGNEOUS ROCKS.

Igneous Rocks. Composition, Texture and Classification, Description and Occurrence. By Joseph P. Iddings. In Two Volumes. Vol. i. Pp. xi+464+3 plates. (1909.) Price 21*s.* net. Vol. ii. Pp. ix+685. (London: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 25*s.* 6*d.* net.

UNIFORM with the "Rock Minerals" of the same author, now in its second edition, the work which Prof. Iddings has now completed will take an assured place as the fullest and most comprehensive treatment of the subject in our language. Nor is it of the nature of a compilation, but presents numerous features of originality. There are novelties which will be cordially welcomed, and others which will probably meet a more doubtful reception. The author has not shrunk from introducing many debatable questions, and has pronounced on them in no uncertain tone. Although the spirit is that of the missionary rather than the controversialist, this somewhat impairs the utility of the work as a hand-book for students.

The first volume, which has been for some time in the hands of petrologists, deals with the composition, texture, and classification of igneous rocks. It includes a good account of the chemical composition of the rocks and of their component minerals, a discussion of the chemistry and physics of rock-magmas, an admirable and well-illustrated chapter on rock-textures, and a statement of the problem of magmatic differentiation. The last three chapters are concerned with the thorny subject of nomenclature and classification. Here we have first a historical sketch, then an arrangement of the principal igneous rocks in a "qualitative" mineralogical scheme, and finally an exposition of the "Quantitative Classification," of which our author is one of the creators.

The second volume, recently issued, deals with the description and occurrence of the rocks, and is divided into two equal parts. The final test of any classificatory scheme is its applicability in practice; and doubtless many petrologists have waited with curiosity to see how the author would develop a systematic treatment of igneous rocks on the lines of the Quantitative Classification. It seems that we may now congratulate him on recognising the impossibility of the task, for the system actually adopted does not differ in general plan from others in current use. The rocks are first divided into those characterised by (1) preponderance of quartz, (2) quartz and felspar, (3) felspar, (4) felspar and felspathoids, (5) felspathoids, and (6) ferro-magnesian minerals. Under each head "phanerites" and "aphanites" are separated, while the subdivisions are again based on mineralogical characters. To introduce the quantitative element, the author has often redefined terms already in use (a practice which he deprecates in others); but he has succeeded in producing a working scheme with less disturbance of accepted usage than we had expected. The principal relic of the specific "Quantitative Classification" is the use of an ideal mineral composition (the "norm") instead of the actual composition.

Nevertheless, there are many signs that the author is reluctant to abandon the conception of a classification laid down *a priori*. The precise boundaries which he demands are to be fixed by arithmetic, not by chemistry. He counts it a defect of the current systems that special importance is attached to the presence of even very small amounts of certain minerals, such as nepheline and leucite; but, as he has himself pointed out (prior to the birth of the Quantitative Classification), the mere appearance of one of these minerals shows that we have crossed a significant boundary-line in respect of chemical composition. Surely it is he, not his critic, who has lost appreciation of "the mathematical precision of stochiometric chemistry" (p. 7).

The second part of the volume we can praise without reserve. It is an account, such as has never been attempted before, of the geographical distribution of igneous rocks over the globe, with special reference to their chemical composition. This has not been merely compiled in the library, but represents the results of much travel and study in many lands. It is illustrated by maps of the several continents, and by more than 1200 analyses. We hope that in another edition some attempt will be made to distinguish on the maps igneous rocks of different geological ages.

A. H.

MATHEMATICS FOR FRENCH FRESHMEN.

Les Principes de l'Analyse Mathématique: Exposé Historique et Critique. By Prof. P. Boutroux. Tome Premier. Pp. xi+547. (Paris: A. Hermann et Fils, 1914.) Price 14 francs.

PROF. BOUTROUX appears to belong to the school of the laughing philosophers; for, like many of his distinguished compatriots, he has composed a work which is amusing as well as learned. His six chapters range from elementary arithmetic to differential equations, and touch upon such things as friendly numbers, magic squares, the transcendency of π, Tartaglia's rhymed rule for solving a cubic, and so on. Altogether, the book is written in a light and elegant style, reminding us of Lucas; it is neither so technical, nor so critical, as its title might suggest.

Sometimes we are inclined to think that the author is poking fun; for instance (p. 50), he suggests that o (zero) is the initial letter of *οὐδέν*! It is scarcely necessary to say that the Greeks adopted the decimal notation, including zero and the nine other digits, after it had been invented by Eastern (probably Indian) mathematicians; and that our zero is almost certainly an enlargement of the dot which is still used by Oriental printers (unless the dot is a contraction for an older circle).

"Bernouilli," instead of Bernoulli, occurs so often that it can scarcely be condoned as a misprint; "Neper" we let pass, as a traditional misspelling; otherwise the names of authors seem to be correct. This is a small matter; a much more important fact is that the author, besides being interested in the discoveries of the ancients, is fully awake to the merits of the moderns. For instance, we have the modern definition of "function"; references to the modern theories of irrational numbers, of functional equations, and the like.

It is interesting to see from the preface that this book is intended to be a "repertorium" for "débutants en mathématiques." As a repertorium it is certainly not one of formulæ; so it must be judged as one of ideas, and since it begins with a quotation from Plato's "Republic," we may suppose that this is what the author means.

From this point of view, the author may be congratulated, because the ideas which he suggests are eternal, though the forms under which he presents them are merely those which seem for the present the most convenient and suitable. One great advantage of the historical treatment of the subject is that it shows how what we may call the machinery of the subject has been improved and simplified.

Prof. Boutroux promises us another volume dealing mainly with analytical geometry, mathematical logic, and infinitesimal calculus; it will also deal with complex quantities and series. Teachers will note that the range of the whole work approximately covers the course of general mathematics in the science faculties of the higher educational bodies in France.

G. B. M.

ANALYTICAL AND SYNTHETICAL CHEMISTRY.

(1) *Industrial Organic Analysis: for the Use of Technical and Analytical Chemists and Students.* By Paul S. Arup. With a foreword by Prof. J. C. Irvine. Pp. xii + 340. (London: J. and A. Churchill, 1913.) Price 7*s.* 6*d.* net.

(2) *A Text-book of Quantitative Chemical Analysis.* By Dr. A. C. Cumming and Dr. S. A. Kay. Pp. xi + 382. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1913.) Price 7*s.* 6*d.* net.

(3) *The Sugars and their Simple Derivatives.* By Dr. J. E. Mackenzie. Pp. xvi + 242. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1913.) Price 7*s.* 6*d.* net.

(4) *The Silicates in Chemistry and Commerce: including the Exposition of a Hexite and Pentite Theory and of a Stereo-chemical Theory of General Application.* By Dr. W. Asch and Dr. D. Asch. Translated, with critical notes and some additions, by Alfred B. Searle. Pp. xx + 456. (London: Constable and Co., Ltd., 1913.) Price 21*s.* net.

(5) *Die Elemente der siebenten Gruppe des periodischen Systems: aus Abegg's der anorganischen Chemie.* Vierter Band. Zweite Abteilung. Herausgegeben von Dr. Fr. Auerbach. Pp. x + 904. (Leipzig: S. Hirzel, 1913.) Price 26 marks.

(1) THIS volume is intended for the use of students who, having received a grounding in theoretical and practical chemistry, are desirous of gaining an insight into the methods of industrial organic analysis. Eight typical series of commercial organic products have been selected, and detailed instructions are given of the analytical processes employed in determining the industrial value of the materials under consideration. The subjects chosen include coal and coke, coal tar and its distillation products, the petroleums, the fatty oils and fats, soap, milk, butter, starch and its degradation products, flour, barley, malt, and the preservatives and colouring matters introduced into foods. One very valuable feature of the book is the references to the larger manuals and special monographs given at the end of each chapter.

In the foreword Prof. Irvine deals with the controversial topic of the college training of industrial chemists. The subject was not new thirty years ago, and although the discussion is unending there is really no general problem to be faced; still less is there any general solution to be provided. Experts differ, and the weighty opinions of Prof. Martin (*sic*) Bogert, President of the Society of Chemical Industry, should be balanced against those of Dr. Messel, his predecessor in this office. The workings of the latter's mind in this connection are adumbrated in the recent creation of two additional Chairs of "pure" chemistry in the Imperial College of Science and Technology. However, if some degree of technical proficiency is insisted on, the student cannot do better than to work through a selection of Mr. Arup's thoroughly practical exercises in industrial analysis.

(2) The authors have arranged this manual so that some knowledge of the principles of quantitative analysis may be acquired by a practical study of the three introductory sections, which include general principles, volumetric analysis, and gravimetric analysis, including electrolytic methods. Owing to its educative value, a thorough training in volumetric analysis is recommended when time permits of little or no gravimetric work. The exercises included in the volumetric section form a very instructive and comprehensive series, involving the use of all the ordinary standard solutions. In view of the great importance attached by the authors to this side of analysis, it is perhaps allowable to suggest that a short description of the chemical nature of the organic indicators (methyl-orange, methyl-red, phenolphthalein) would have made the volumetric section more self-contained. The preliminary chapters are followed by sections devoted to colorimetric methods, systematic quantitative analysis, and the analysis of simple ores and alloys. Modern methods have been selected, among which may be indicated the estimation of potassium as perchlorate and the separation of iron from allied metals in acid solution by the use of "cupferron," the ammonium salt of nitrosophenylhydroxylamine. The appendix contains details of the preparation of this useful organic reagent. The section on gas analysis refers to the use of the simpler forms of apparatus, such as the Lunge nitrometer and the apparatus devised by Hempel and by Orsat. Water analysis is included as an introduction to the estimation of substances present only in traces. The short section on ultimate organic analysis would have been rendered more complete by a brief reference to the Carius method for the halogens and sulphur. The determination of molecular weights includes details of the vapour density, cryoscopic and ebullioscopic methods.

(3) This treatise is a very readable monograph on the sugars and their immediate derivatives, based on a course of lectures given at the Birkbeck College and in the University of Edinburgh. Rightly on account of their intrinsic importance three chapters each are devoted to cane sugar and glucose, these sections being a mine of information in regard to these well-studied sugars. Among the many researches summarised may be mentioned those on the methyl glucoses, the methyl glucosides, and their acetyl derivatives. One very interesting chapter is that relating to the configuration of the sugars, in which the stereochemical relationships of these compounds are fully discussed. Succeeding chapters deal with dioses, trioses, tetroses, pentoses, together with the naturally occurring mannose, *d*-fructose (lævulose), and raffinose. The less important synthetic sugars are also reviewed. A synopsis is furnished of the glucosides found in plants, and the concluding sections deal with fermentation and with the metabolic changes attending the use of sugars and allied carbohydrates as foodstuffs. References are given throughout to original sources of information, and the work is provided with complete author and subject indexes.

(4) It is impossible within the space available to discuss in detail the hexite–pentite theory devised by the authors, in the first instance, to explain the constitution of the naturally occurring aluminosilicates, and subsequently employed to elucidate the chemical structure of clays, ultramarines, glasses, glazes, porcelains, dental cements, hydraulic cements, and especially Portland cements. It is assumed that five or six molecules of hydrated silica, $Si(OH)_4$, unite with partial elimination of water to form cyclic systems containing five or six silica residues, these complexes being termed respectively silicon pentite and hexite. Aluminium pentite and hexite arise in a similar way by the condensation of five and six molecules of hydrated alumina, $Al(OH)_3$. The mineral aluminosilicates are regarded either as complex acids composed essentially of combinations of these silicon and aluminium pentite and hexite rings, or as salts of these acids when the hydroxylic hydrogens are more or less replaced by metallic elements. The felspars, micas, scapolites, etc., need no longer be regarded as molecular compounds belonging to different mineral groups; they can all be represented as unitary atomic compounds of the same class with definite structural formulæ. A similar hexite–pentite hypothesis is employed to explain the constitution of vanadic, molybdic, and tungstic complexes.

The translator, who has added several instructive and critical notes, doubts whether the authors are justified in extending their views to explain the plasticity of clays. The authors' theory has already been criticised by several writers, and the present volume contains many polemical replies, notably in connection with the constitution and hardening of Portland cements. These hydraulic cements are considered to be basic lime salts of complex aluminosilicic acids containing coalesced hexite and pentite rings with calcium oxide side-chains replacing the hydroxyls of the hydrated silicon complexes, and occasionally containing alkali metals similarly attached to the aluminium hexite rings.

It is highly probable that the refractory oxides, silica, alumina, and their allies exist in highly complex molecules, and since among both inorganic and organic compounds there exists a certain tendency for the formation of five- and six-membered rings, it would probably be accepted by most chemists as a working hypothesis that such cyclic systems occur in the natural and artificial aluminosilicates and their derivatives, but it is open to doubt whether the authors do not greatly prejudice their case by attempting to extend this hypothesis to the explanation of the facts of coordination, radioactivity, and the constitution of organic substances, such as benzene, the artificial colouring matters, and the proteins.

(5) The appearance of this volume is a welcome indication that this monumental treatise on inorganic chemistry will be brought to completion in spite of the untimely death of its originator, the late Prof. Richard Abegg. There still remain for consideration, however, several important groups of elements, and the remaining volumes of the work are eagerly awaited by all interested in the systematic study of the chemical elements. A praiseworthy feature of the treatise so far as it has yet appeared is the thoroughness with which the compilers have accepted the periodic classification of the elements; this insures uniformity of arrangement, and renders the task of reference a very easy one. It is rarely necessary to turn to the indexes. The present volume is devoted to the halogens and manganese, the elements of the seventh periodic group. In the case of each element the opening section deals with the determination of its atomic weight. The descriptions of the physical and chemical properties of the elements and their compounds are very complete, and include, in addition, the mathematical treatment of many important examples of chemical equilibria, such as the Deacon's chlorine process, the variations in the vapour density of the halogens and their partition coefficients in various solvents. Special sections deal with the colloidal chemistry of the halogens and manganese.

The bibliography is remarkably full, there being more than fifteen hundred references for iodine and its derivatives alone. Manganese varies considerably in its habit of combination, and its compounds are arranged whenever possible under the headings of the various valencies of the metal, but reference is also made to its alloys, and to compounds in which the valency of the metal is undetermined.

G. T. M.

TEXTILES.

Textiles: a Handbook for the Student and the Consumer. By Mary S. Woolman and Ellen B. McGowan. Pp. xi+428. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 8*s*. 6*d*. net.

THIS book strikes a new note from an educational point of view, and represents a serious attempt to present a course of instruction to students who intend to make some branch of textile work their future business, or who are, or will be, the buyers of textiles for personal or household purposes. Whilst its strongest appeal is to students of the type mentioned, the matter is so arranged that it offers a mass of information to a wide range of readers who are out of touch with technical methods, and yet are seriously concerned and interested about the character of the textile materials they sell, purchase, or use. It fills the wide gap at present existing in the domestic economy course of instruction in our colleges and schools, and as it deals with practically all kinds of fibres and the textiles into which they are made, it presents in a most interesting manner a remarkably concise and exact description of the methods and machinery used for producing the various materials.

Unusually full details are given for distinguishing the constituents of any textile material, to detect frauds and to estimate value. The character of the various types of dyes and their use, together with notes on finishing and laundry work, add materially to the value of the book. The last three chapters deal with the hygiene of clothing, economic and social aspects, and a series of clothing budgets, these latter being unusually complete and valuable as guides in the laying out of money the clothing of families and individuals of various degrees of economic status.

The book represents a well-defined arrangement of accurate information gathered from a multitude of sources, chiefly of a highly technical nature, and rewritten in a simple and interesting manner with a very clear view to their utilisation by those who are, after all, the consumers of all that is produced by the vast number of our textile factories and workshops, and on whom these innumerable industries depend for their existence. In addition to its value as a text-book on domestic economy, it is well worthy of a place in every textile-worker's library, and can be recommended as a reference book in the household.

WM. SCOTT TAGGART.

OUR BOOKSHELF.

The Reform of the Calendar. By Alexander Philip, Pp. xiii + 127. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1914.) Price 4*s.* 6*d.* net.

MR. PHILIP reminds us that, apart from minor notes, we have discussed different aspects of calendar reform already in these columns (April 27 and October 26, 1911). The reader who looks for enthusiastic advocacy of some change and an account of the various proposals which have been put forward in recent years may be referred to this little book on the subject.

We wish to speak of Mr. Philip with some respect. Not that we regard calendar-making as a high order of achievement, although Mr. Philip's original scheme was probably as good as any other of its class, and certainly a great deal better than some. But he has also the broad mind which appreciates objections and prejudices, and he has been led to reduce his first proposal to a minimum adjustment of the days of the months. The week is left undisturbed, and his present scheme may be represented thus:—

Jan. 31	Feb. 30	Mar. 30	April 31	May 30	June 30 (31)
July 31	Aug. 30	Sept. 30	Oct. 31	Nov. 30	Dec. 31

Perhaps something might be said in favour of interchanging the second and fourth quarters so as to bring leap day (when it occurs) to the end of the year. But little can be seriously urged against a change which makes the months and quarters more equal and introduces an approximately rhythmic (? dactylic) arrangement. What is to be feared rather is that so slight an adjustment offers so small an advantage, in spite of Mr. Philip's glowing optimism, as to lack the necessary driving force for its adoption. Does there indeed exist a practical middle course between the Scylla of traditional prejudice and the Charybdis of triviality?

H. C. P.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditeranée. By C. Houard. Tome Troisième. Supplément: 1909–1912. Pp. 1249–1560. (Paris: A. Hermann et Fils, 1913.) Price 10 francs.

THE rapid progress of cecidology has led Prof. C. Houard to publish a supplement to his two indispensable volumes on the Animal Galls of Europe. This third volume deals with what has been done between 1909 and 1912, and it is astonishing to find a registration of 1,300 new galls, bringing up the total to 7,556! The author has exercised discretion in what he has included, and he makes an appeal to those interested in galls—and what naturalist is not?—to refrain from rushing into print with new discoveries until they have studied them for, say, two successive years! Everything has been done in the way of double entry and bibliography to make the catalogue serviceable, and both pagination and enumeration are in continuity with the previous volumes. There are 201 illustrations, and there is an appropriate frontispiece with photographs of Rübsaamen, Kieffer, Massalongo, and the late Prof. Giard.

The Principle of Relativity in the Light of the Philosophy of Science. By Paul Carus. Pp. 105. (London and Chicago: The Open Court Publishing Co., 1913.) Price 4*s.* net.

THE author of this work has made up his mind in advance that the question of relativity is a philosophical problem. It is therefore necessary for him to dismiss contemptuously all the history of the purely physical principle technically known as "the principle of relativity." To say as he does that the Michelson-Morley experiment "assuredly has nothing to do with the principle of relativity" is simply to say that the principle is not what it is. The author refuses to call the principle a hypothesis, and asserts "that it is an *a priori* proposition, a postulate of pure thought which either holds good universally or has no validity whatever."

Whatever opinion may be held on this point, it is impossible to say that to the student of dynamics there is no difference in status between rotation and translation. If relativity is a requirement of pure thought, why cannot Newton's laws of motion be used equally well for two frames of reference, of which one is in rotational motion relative to the other? Are those laws wrong, or is pure thought irrelevant to dynamics? One aspect of the principle of relativity is that we do know whether it is convenient to think of a system as having no rotation. This is a matter of common experience. If pure thought denies it, it is clear that it is thinking about something other than the facts with which experiment deals.

Nature and the Idealist. Essays and Poems. By H. D. Shawcross. Pp. xii + 186. (London: Sampson Low, Marston and Co., Ltd. n.d.) Price 5*s.* net.

THE late Mr. Shawcross died last year at the early age of twenty-nine. He was a newspaper journalist whose work had to be done in a busy Lancashire town, though all his instincts and his love for nature would have taken him into the country. His essays and poems reveal much of the struggle he continually had and their merit suggests that had he lived longer he would have become known as a poet and essayist to a wide circle of lovers of nature.

LETTERS TO THE EDITOR.

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

The Sand-Blast.

AMONG the many remarkable anticipations contained in T. Young's lectures on natural philosophy (1807) is that in which he explains the effect of what is now commonly known as the sand-blast. On p. 144 he writes :—"There is, however, a limit beyond which the velocity of a body striking another cannot be increased without overcoming its resilience, and breaking it, however small the bulk of the first body may be, and this limit depends on the inertia of the parts of the second body, which must not be disregarded when they are impelled with a considerable velocity. For it is demonstrable that there is a certain velocity, dependent on the nature of a substance, with which the effect of any impulse or pressure is transmitted through it; a certain portion of time, which is shorter accordingly as the body is more elastic, being required for the propagation of the force through any part of it; and if the actual velocity of any impulse be in a greater proportion to this velocity than the extension or compression, of which the substance is capable, is to its whole length, it is obvious that a separation must be produced, since no parts can be extended or compressed which are not yet affected by the impulse, and the length of the portion affected at any instant is not sufficient to allow the required extension or compression. Thus if the velocity with which an impression is transmitted by a certain kind of sound be 15,000 ft. in a second, and it be susceptible of compression to the extent of 1/200 of its length, the greatest velocity that it can resist will be 75 ft. in a second, which is equal to that of a body falling from a height of about 90 ft."

Doubtless this passage was unknown to O. Reynolds when, with customary penetration, in his paper on the sand-blast (*Phil. Mag.*, vol. xlvi., p. 337, 1873) he emphasises that "the intensity of the pressure between bodies on first impact is independent of the size of the bodies."

After his manner, Young was over-concise, and it is not clear precisely what circumstances he had in contemplation. Probably it was the longitudinal impact of bars, and at any rate this affords a convenient example. We may begin by supposing the bars to be of the same length, material, and section, and before impact to be moving with equal and opposite velocities v. At impact the impinging faces are reduced to rest, and remain at rest so long as the bars are in contact at all. This condition of rest is propagated in each bar as a wave moving with a velocity a, characteristic of the material. In such a progressive wave there is a general relation between the particle-velocity (estimated relatively to the parts outside the wave) and the compression (e), viz., that the velocity is equal to ae. In the present case the relative particle-velocity is v, so that $v=ae$. The limit of the strength of the material is reached when e has a certain value, and from this the greatest value of v (*half* the original relative velocity) which the bars can bear is immediately inferred.

But the importance of the conclusion depends upon an extension now to be considered. It will be seen that the length of the bars does not enter into the question. Neither does the equality of the lengths. However short one of them may be, we may contemplate an interval after first impact so short that the wave will not have reached the further end, and then the argument remains unaffected. However short one of the impinging bars, the above calculated relative velocity is the highest which the material can bear without undergoing disruption.

As more closely related to practice, the case of two spheres of radii r, r', impinging directly with relative velocity v, is worthy of consideration. According to ordinary elastic theory the only remaining data of the problem are the densities ρ, ρ', and the elasticities. The latter may be taken to be the Young's moduli q, q', and the Poisson's ratios, σ, σ', of which the two last are purely numerical. The same may be said of the ratios q'/q, ρ'/ρ, and r'/r. So far as dimensional quantities are concerned, any maximum strain e may be regarded as a function of r, v, q, and ρ. The two last can occur only in the combination q/ρ, since strain is of no dimensions. Moreover, $q/\rho=a^2$, where a is a velocity. Regarding e as a function of r, v, and a, we see that v and a can occur only as the ratio v/a, and that r cannot appear at all. The maximum strain then is independent of the linear scale; and if the rupture depends only on the maximum strain, it is as likely to occur with small spheres as with large ones. The most interesting case occurs when one sphere is very large relatively to the other, as when a grain of sand impinges upon a glass surface. If the velocity of impact be given, the glass is as likely to be broken by a small grain as by a much larger one. It may be remarked that this conclusion would be upset if rupture depends upon the *duration* of a strain as well as upon its *magnitude*.

The general argument from dynamical similarity that the maximum strain during impact is independent of linear scale, is, of course, not limited to the case of spheres, which has been chosen merely for convenience of statement.

RAYLEIGH.

The Earth's Contraction.

THE conclusion of the Rev. Osmond Fisher (NATURE, February 26) that if the moon originated as a detached portion of the earth, the earth's radius at the time (even allowing for the much more rapid rate of rotation indicated by Sir G. H. Darwin's researches) must have been about three times its present one, leads to a very interesting speculation, namely, as to whether the earth's radius may not have contracted very considerably *within the time represented by the known geological formations*. There is, I think, observational evidence which warrants us in believing this to have been the case.

Prof. Heim estimated the linear compression required to produce the Alps at seventy-four miles, which means a reduction of the earth's radius by twelve miles, or 0·3 per cent. Taking the whole of the existing mountain ranges, we may roughly estimate a total reduction of ten times this amount, or 3 per cent., as being indicated since the middle of the Tertiary epoch. Yielding of the earth's crust by intense folding has probably always taken place in particular areas, but it is a fact that as a whole the rocks show more and more folding, faulting, and overthrusting the farther back we go into the geological record, and the mountains formed in the older epochs have long since been removed by denudation, which was naturally most active where the plication was most intense. Taking the rock-structures alone into consideration, would any geologist who has worked extensively amongst the oldest fossiliferous rocks affirm that the evidences are against a contraction of the earth's radius of the order of 20 per cent. since they were deposited? A contraction of this magnitude would be accommodated by a continuous folding of the crust into anticlines and synclines at angles of 37° with the horizontal, and most accounts of the tectonics of the earlier Palæozoic rocks describe folding and shearing which approach this average, though, of course, there are some extensive areas where the disturbance has been much less. When we come to the Archæan rocks the case is even stronger.

A very simple calculation shows that the amount of contraction suggested above implies only a rate of shrinkage so slow that if going on at present it would fail to be detected by the most refined geodetic measurements repeated after a century. A contraction of the earth's radius of only three inches a year, which would cause a 20 per cent. diminution of the radius in about twenty million years (and this is probably a low estimate for the age of the Cambrian strata) would only change the absolute length of geodetic lines by less than one part in a million in a hundred years. Observations of the lunar parallax, which afford another theoretical means of detecting changes of the earth's radius, would have to be repeated at intervals of twenty-five thousand years in order to detect a single second of diminution, even if we could assume the moon's mean distance to be constant throughout this period.

If the hypothesis of a continuous contraction of the earth's radius at an average rate of somewhere about three inches a year throughout geological time is entertained, it not only furnishes a plausible explanation of the prevalent folding of the ancient rocks, but also tempts one to indulge in a number of other speculations, such as, for instance, how far the flying-powers of the great Mesozoic reptiles may have been influenced by the lesser value of gravity at the earth's surface with a larger terrestrial radius and a greater speed of rotation. But collateral issues may well rest until the main point has been argued, and as to this I should like the opinion of geologists whose experience of the older formations has been greater than my own. I am at present surveying in a disturbed country where I should certainly have had to correct my base-line very considerably for dislevelment if I had measured it along the planes of stratification of the rocks, and this circumstance has suggested the question to my mind on reading Mr. Fisher's letter.

John Ball.

Wadi Shellal, Sinai, March 31.

Zoological Classification.

The complaint, thus entitled, of Mr. H. C. Williamson in Nature for April 9, p. 135, is a fairly common one just now, and his way of putting it suggests some remarks from the other side.

The zoological classification of this or any other day is "satisfactory" in proportion, first, as the principles of that classification commend themselves to the general intelligence of zoologists; secondly, as the classification is in agreement with those principles. The multiplication of the units to be classified, whether subspecies, species, or genera, can have no bearing on the validity of the classification.

The object of classification is the arrangement, but not the nomenclature, of the units.

The older genera have been subdivided, not merely because the number of species has proved unwieldy (indeed, if the necessary bases be absent, such genera cannot be split, however much it be desired), nor merely because it has proved possible to group the species (for in this case subgeneric divisions are adequate), but because study has shown that the species formerly included in a genus have not really the close interrelationship which such inclusion implies, but are of very diverse descent. In nomenclature as affected by classification most of the serious difficulties which happen to have come under my own notice are due to our increased, but still imperfect, knowledge of origins.

The real trouble and source of disagreement between zoologists is that some (and especially the "applied" workers) look at taxonomy with the eyes of the old school, which regarded only the amount of resemblance in structure, while others follow the new school which seeks to express history and relationship. In a word, there are two sets of principles, and our classification is, if not halting between the two, at least passing rather lamely from one to the other. And as for nomenclature, the trouble is that the Linnean system was devised for a classification on the old principles, and one often doubts how far it is applicable to the new method.

When the nature of our difficulties is clearly understood, nobody will propose to effect progress by such retracing of our steps as "the extinction of half at least of the genera." In ordinary writing one practical way of getting round the difficulty is half hinted at in Mr. Williamson's last sentence; it is to use the family name. Thus we can speak of a Cidarid, a Terebratulid, a Phacopid, a Pentacrinid. Or the transition may be eased by using the old name with some such *caveat* as *sensu lato*, *e.g.* Rhynchonella (s. l.), Antedon (s. l.). In writing the "Guide to the Fossil Invertebrate Animals in the British Museum" the conflict between accuracy and intelligibility was settled by adding the older better-known name within square brackets after the correct or modern generic name, *e.g. Dalmanites* [*Phacops*] *caudatus*.

F. A. Bather.

Natural History Museum, April 11.

Electric Emissivity at High Temperatures.

We have recently conducted at the National Physical Laboratory some experiments on the emission of electricity from a number of substances at very high temperatures—between 2000° C. and 2500° C. The experiments were carried out in a carbon-tube resistance furnace at atmospheric pressure. Among the substances tried were the alkaline earths and a number of metals. In every instance the temperature was sufficient to vaporise rapidly the substance under test, and, under these conditions, very large amounts of electricity were emitted. For example, barium oxide emitted negative currents of the order of 4 amperes per sq. cm., while boiling tin gave currents of about 2 amperes per sq. cm. No external potential was applied in any of the experiments.

We hope to publish very shortly a full discussion of the results.

G. W. C. Kaye.
W. F. Higgins.

National Physical Laboratory, Teddington, Middlesex, April 22.

An Optical Illusion.

Some days ago I was reading, the sunrays falling aslant on my forehead, it being about five o'clock p.m. After having read awhile, the letters showed a vivid red, the paper itself retaining its white colour. The rays did not fall on either of the two sides of the page.

When I used my hand to shade the eyes, the letters *immediately* became black again. On removing my hand, it took them some seconds to change from black through dark red to bright red. I may add that I am short-sighted, but was reading without spectacles.

I should feel obliged if some reader of Nature would give me an explanation of this.

J. W. Giltay.

Delft, Holland, April 11.

THE NATIONAL BOTANIC GARDENS OF SOUTH AFRICA.

It is perhaps difficult to appreciate in their due proportion the various factors that have been instrumental in founding these National Botanic Gardens. At the same time it is necessary to make the attempt; for their future development must be influenced, if not controlled, by the ideals entertained by those who for many years have been working for what has at length been achieved.

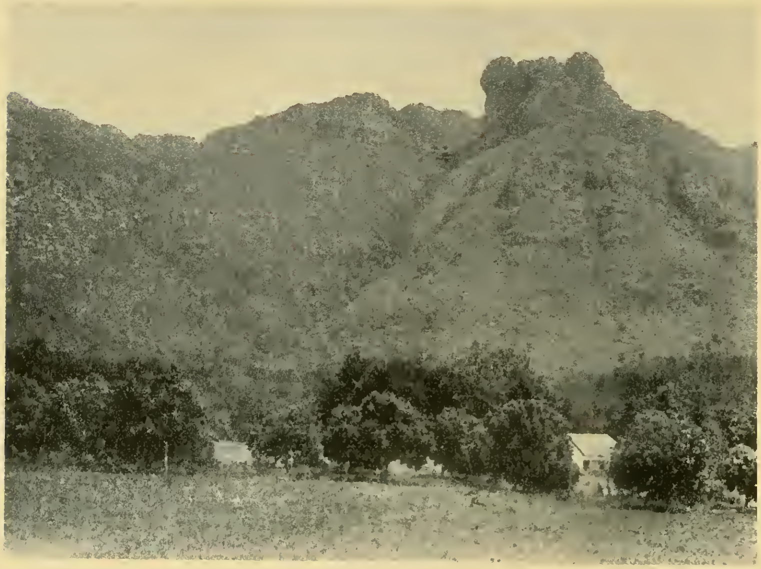

FIG. 1.—National Botanic Gardens. Looking westwards from within the eastern boundary. Curator's house on the right; in front of it, part of the Camphor Avenue running obliquely across the picture. The western boundary runs immediately beneath the steep rocks about 1200 ft. above the curator's house.

Among these factors a very important place must be assigned to the keen interest displayed by almost the whole white population in the remarkable vegetation of the country. The manifestation of this interest has in many cases endangered the existence of ornamental species. Most districts furnish examples of the disastrous effects of reckless wood-cutting or ill-judged burning. Public opinion has awakened somewhat tardily to the necessity for conservative action. Recent legislation has given a measure of protection to certain of the threatened forms. But it is now generally realised that the problem is too big to be solved by the protection of a few favourites. That the reservation of areas is more adequate to the circumstances than the protection of individual species is recognised. And further, there has gradually been developed a tendency to adopt the positive measure of introducing native plants into cultivation in South African gardens.

There can be no doubt that the movement to establish a national botanic garden has received great impetus from the widely felt desire to see this tendency accelerated. Its first mission is to lead the way in the preservation and cultivation of South African plants, and in the improvement of those of them that, for various reasons, are worthy of improvement.

Kirstenbosch possesses exceptional facilities for dealing with these problems. Of its total area of about 600 acres,[1] approximately two-thirds is well-stocked with native species, representing all the more important plant associations of the region. Half this area is clothed with indigenous forest, the rest mainly with low bush in which proteas, heaths, orchids, restiaceæ, and many striking compositæ and leguminosæ are conspicuous. This area is admirably suited for development into a most instructive miniature of what would be called in America a "national park."

During the six months ending on December 31 last, about 1500 species, the vast majority not indigenous to Kirstenbosch, have been sent in by correspondents from various parts of the coast-region between Damaraland and Zululand, the Karoo and Upper Region, Swaziland, Transvaal, Bechuanaland, Rhodesia, and British East Africa.

FIG. 2.—National Botanic Gardens. Looking westwards near the southern boundary. A silver tree forest (*Leucadendron argenteum*).

Among these contributions a large proportion are succulents. Probably a greater variety of South

[1] Since the establishment of the gardens an additional area of about 200 acres has been added at the southern end of the original Kirstenbosch estate.

African bulbs and ground orchids than has yet been brought together in one place is already established in the nursery. Most of these were introduced here during the winter rains, which have been followed by an exceptionally wet summer. The results are such that any doubt that may have been entertained as to the possibility of establishing here a representative collection of South African—one may almost say African—plants is set at rest.

Most of those who have taken an active part in the foundation of these gardens will not be satisfied merely with the collection and cultivation of South African plants. The educational effect of such a collection will nevertheless not be small. The great extent of the country and the sharpness of its physical divisions militate against the slowly growing sense of national unity. The presentation, even on a small scale, of typical representatives of its regional floras to the view of many who of necessity are acquainted with but little of its area, must do something towards the obliteration of hard dividing lines.

Fig. 3.—National Botanic Gardens. Group of *Aloe succotrina*. This is part of a very remarkable plant association about five acres in extent, on a steep slope strewn with large blocks of Table-mountain sandstone, 1500 ft. s.m. Associated with the aloes are lichen-covered trees of *Olea verrucosa*, *Cunonia capensis*, *Maurocenia frangularia*, *Plectronia* sp., etc., and a number of moisture-loving annuals, ferns and mosses.

From a purely scientific point of view, the importance of the National Botanic Gardens depends upon the use that is made of them for purposes of investigation. It is clearly realised that they will fall short of justifying their existence if they fail to make adequate provision for the proper study of the material they contain. Whether this provision will come through the much-needed university, or partly or entirely by private benefaction, or through some other channel, remains to be seen. The work at present in progress is ordered on the assumption that such provision will be made in the near future.

Since the publication of Pappe's "Floræ capensis Medicæ Prodromus" (1850), it has been known that a very large number of native species are, or have been, in use locally for medicinal or other domestic purposes. Plants yielding essential oils and other products of probable or possible economic value are numerous. While much of the work of acclimatisation, which in tropical countries has been done by the Botanic Garden, is here receiving adequate attention in the departments of agriculture and forestry, there are yet very many exotic plants worthy of attention, the possibilities of which await investigation. Among these the drug- and perfume-yielding species of the Mediterranean region are conspicuous. The economic garden, for which some twenty to thirty acres have been reserved, should therefore become an important part of the establishment.

The functions assigned to the National Botanic Gardens cover a wide range. At present much of the equipment which will make it possible to fulfil them is to seek. But the gardens exist in response to a popular demand, and popular support to make their future secure will not be wanting.

WAVES IN SAND AND SNOW.[1]

Dr. Vaughan Cornish has written a charming book, full of interesting observations. He starts with descriptions of waves and ripples in blown sand, and passes later to the similar forms produced under water, giving many good photographs to illustrate their various characteristics. Whether the waves are large or small, or whether formed by wind or water, it is obvious that the same causes are at work, and the author rightly distinguishes these waves from drifts and sand banks, the latter having their lengths parallel to the direction of the average stream, while the ridges of the waves are at right angles to it. The origin of the lateral drift which gives rise to sand-banks was first explained by W. Froude and independently by Prof. James Thomson about the same time.

Snow waves and snow drifts, and other forms of accumulations of snow, are described in chapters iii. and iv., and these also are well shown by photographs. The phenomena of snow are much more complex than those of sand, both on account of the variable size of the snow-flakes and particles and of the varying conditions as to moisture and temperature in which they are deposited. In some states snow particles cohere on contact; in others when the temperature is low they behave more like a dry powder, and it re-

[1] "Waves of Sand and Snow and the Eddies which Make Them." By Dr. Vaughan Cornish. Pp. 383+plates. (London: T. Fisher Unwin, n.d.) Price 10*s*. net.

quires a pressure applied for some time to make them stick together. The resulting forms taken by accumulations near obstacles differ considerably in consequence.

One of the most interesting observations in the book relates to the natural sifting which sand undergoes whilst being blown hither and thither by the wind. One sample of desert sand was passed by the author through a series of wire gauze sieves of graduated mesh; a single sieve with a 1/48 in. mesh retained 94 per cent. of the total, the sieve above with a 1/24 in. mesh stopping 2 per cent. and the one below with a 1/96 in. mesh stopping 4 per cent. Practically, therefore, 94 per cent. of the sand grains had linear dimensions of between 0·02 and 0·01 in.

It would have been of interest if this sorting test had been carried further, for several phenomena of sand, notably "singing sand," and also the extraordinary roar which is sometimes heard when a slip occurs in a slope of blown sand, must depend on the uniformity of the size of the grains. Darwin in his voyage of the *Beagle* refers in chapter xvi. to a hill in Chile known as "El Bramante," on account of the roaring sound produced by the slipping of sand, and also states that the same circumstances are described in detail by Leetzen and Ehrenberg as the cause of the sounds which have been heard by many travellers on Mount Sinai. I have had a description from a friend who, with a party, was descending a slope of blown sand drifted against a cliff in the Nile valley. So far as could be seen, only a small surface flow of sand started by their footsteps appeared to be in motion, but the noise gradually increased to a loud roar, and the whole mass of the drift seemed to vibrate. This implies that each grain was doing the same thing at the same time for a considerable depth, which could scarcely happen were there not a fairly close uniformity in their size.

How the sorting is carried out by the wind does not clearly appear. Dr. Cornish's explanation is that the predominant size of grain is reached when mutual attrition ceases. If this is correct, it might be possible to determine the size in terms of the hardness of the material and the $\sqrt{}$mean square velocity of impact. There is no doubt a definite size for which the whole work of impact could be taken up by elasticity and without rupture. The whole question, however, of the way in which dust is raised by the wind is rather obscure. Presumably the wind in contact with the ground must move parallel to its surface, and it seems probable that particles drifting along the surface can only be raised above it by impact more or less oblique with others which are stationary or moving with a different velocity. Once they are lifted into the eddying current their further distribution does not present the same sort of difficulty.

FIG. 1.—A nine-foot snow-mushroom seen from below. From "Waves of Sand and Snow."

Any structure which shows a "period" always presents interesting problems, but the periods and wave-lengths which Dr. Cornish deals with must not be confused with those belonging to stable systems, such as water waves, etc. The latter are definite in the same way and for the same reason as the period of a pendulum.

The sand waves are products of instability, and in all quasi-periodic structures which originate in this way the amplitude and wave-length are independent. In this they differ from stable systems which are isochronous. In the unstable systems a change, however small, tends to increase until a limit is reached at which a breakdown of some sort occurs. Instances might be given in great variety in which instability leads to a quasi-periodic motion or arrangement. Geysers which boil over at fairly constant intervals, the whistling of the wind (here the period is the rate of production of eddies round small obstacles), and the ladder-like shavings taken off various materials by cutting tools, are all cases in point, although drawn from such different quarters.

FIG. 2.—Aeolian sand-ripples at Southbourne. From "Waves of Sand and Snow."

Notice of many of the matters of which the author treats, such as snow mushrooms, and the ridges trodden out by cattle, must be omitted for want of space, and although it must be said that the explanations are not as good as the descriptions, the book is to be recommended as the most interesting collection of observations concerning the whole subject which has yet appeared.

A. MALLOCK.

MUTATIONS OF BACTERIA.

VARIOUS alterations in the morphology and in physiological characters of certain bacteria have been obtained by many observers. Thus *Bacillus coli*, the plague bacillus, and other organisms show considerable variation in the size of the cells on different culture media; the *Bacillus prodigiosus*, which forms a brilliant red pigment when grown at ordinary temperatures, completely loses the power of pigment production after cultivation at blood heat, at which temperature (98° F.) it grows as luxuriantly as at 65° F. Twort and Penfold have "educated" the typhoid bacillus to ferment sugars which ordinarily it does not attack, and Revis has obtained marked varieties of *Bacillus coli*, morphological and physiological, by prolonged culture in various media. Minchin holds that if there be no syngamy (sexual reproduction, *e.g.* conjugation) among bacteria, as seems to be the case, the so-called species of bacteria are to be regarded as mere races or strains, capable of modification in any direction.

A marked instance of the artificial production of mutations of *Bacillus anthracis*, a particularly well-defined and stable bacterial species (Fig. 1), is described by Mme. Victor Henri (*Compt. rend. Acad. Sci.*, vol. clviii., No. 14, 1914, p. 1032). The method employed was to expose an aqueous suspension of sporing anthrax in a quartz tube to ultra-violet radiations for times varying from one to forty minutes, and afterwards subculturing.

Whereas the majority of the organisms was killed by this treatment, the ultra-violet rays being markedly bactericidal, a few survived. Of the

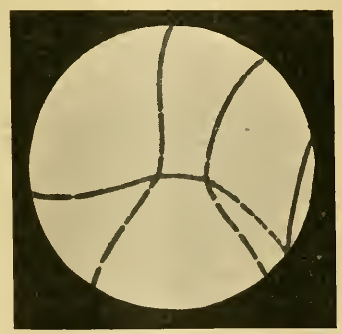

FIG. 1.

FIG. 2.

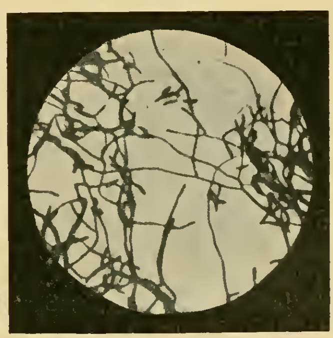

FIG. 3.

latter, while most presented a normal aspect, a few showed characters decidedly different from the typical anthrax bacillus. The principal of these were (*a*) coccoid forms (Fig. 2) which remained stable during a period of two months; (*b*) thin filamentous forms (Fig. 3), not taking Gram's stain, not liquefying gelatin, nor curdling milk, and producing an infection different from anthrax on inoculation. This form remained absolutely fixed after daily subculture for more than eighty days; but, though stable *in vitro, in vivo,* after passage through an animal, Gram-positive coccoid forms made their appearance, and subsequently, after subculture in broth, a certain number of bacillary forms, approximating to typical anthrax, were obtained. These experiments open up wide possibilities in the transformation of micro-organisms. R. T. Hewlett.

NOTES.

The first of the two annual soirees of the Royal Society will be held in the rooms of the society at Burlington House on Wednesday, May 13.

The twenty-second James Forrest lecture of the Institution of Civil Engineers will be delivered on Tuesday, May 5, by Mr. F. W. Lanchester, upon the subject of "The Flying Machine from an Engineering Standpoint."

Prof. C. S. Sherrington, Waynflete professor of physiology in the University of Oxford, has been elected a member of the Royal Danish Academy of Sciences, in the class of natural sciences.

The death is announced, at fifty-eight years of age, of Prof. Adolf Fischer, director of the Museum for Asiatic art, founded last October at Cologne, and consisting almost entirely of collections made by Prof. Fischer himself during repeated journey to the Far East.

The death on March 19 is announced of Prof. G. Mercalli, one of the leading Italian seismologists. Mercalli, who was born at Milan in 1850, is known chiefly for his researches on regional seismology, for his observations on Vesuvian phenomena, and for his scale of seismic intensity, which, in Italy, has displaced the widely used Rossi-Forel scale. In conjunction with Prof. T. Taramelli, he issued the principal reports on the Andalusian earthquake of 1884 and the Riviera earthquake of 1887. In 1897, were published his valuable monographs on the earthquakes of Liguria and Piedmont, and of southern Calabria and the Messinese district. At the time of his death he was director of the Vesuvius Observatory and professor of seismology in the University of Naples.

Two articles on the work of the late Prof. Milne have appeared this month, one by Dr. C. Davison, in *Science Progress*, the other by Comte de Montessus de Ballore, in the Bulletin of the Seismological Society of America (vol. iv., pp. 1–24). The former contains a brief account of his life and a summary of the principal work accomplished by him. The latter is more bibliographical in form. Milne's papers are classified and briefly described under fourteen headings, such as earthquake-catalogues, earth tremors and pulsations, aseismic buildings and practical seismology, relations between earthquakes and variations of the vertical and changes of latitude, etc. Both writers claim for Milne the chief share in the growth of seismology.

The twelfth annual meeting of the South African Association for the Advancement of Science will be held at Kimberley from Monday, July 6, to Saturday, July 11, inclusive, under the presidency of Prof. R. Marloth. The sections and their presidents will be as follows:—A, Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation, Prof. A. Ogg; B, Chemistry, Geology, Metallurgy, Mineralogy, and Geography, Prof. G. H. Stanley; C, Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene, and Sanitary Science, Prof. G. Potts; D, Anthropology, Ethnology, Education, History, Mental Science, Philology, Political Economy, Sociology, and Statistics, Prof. W. Ritchie.

The precise physical cause which has brought the publicity of newspaper paragraphs to the shrinkage of the Caspian Sea must be, pending the official investigation by Prof. Shokalski, a matter for conjecture. That the surface of the sea stood formerly, and at no remote geological date, at a much higher level, and that its extent was much greater, is well known. Again, the level is subject to recognised fluctuations, both annually and over longer periods. The discharge of the several great rivers into the sea strives constantly but often unsuccessfully to keep up with the loss by evaporation. The level usually stands highest in the middle of the year, and lowest at the beginning. As to the fluctuations of longer period, observations extending from 1851 to 1885 showed maxima of height in 1868–69, in 1882, and in 1885, and minima in 1853 and 1873; these oscillations appear to have had an extreme range of some 42 in. The present fall may be associated with this phenomenon; a scientific investigation towards the close of last century led to the conclusion that no perceptible permanent shrinkage was in progress.

A summary of the weather for the first three months of the year has been given by the Meteorological Office in its Weekly Weather Report for the period ending April 4. The mean temperature for the whole period is shown to be in excess of the average in every district of the United Kingdom. In the east and north-east of England the excess of temperature amounted to 3°, and in the midland counties and in the south-east, north-west, and south-west of England the excess was 2°. In all other districts which comprise Scotland, Ireland, and the Channel Islands, the excess of temperature was only 1°. There was an excess of rainfall over the entire kingdom except in the north-east of England, where the fall was only 95 per cent. of the average. In the south-east of England the rainfall for the three months was 160 per cent. of the average, in the east of England 145 per cent., in the Channel Islands 143 per cent., in the south-west of England 142 per cent., in Ireland, north and south, 140 per cent., and in the east and west of Scotland 122 and 123 per cent. respectively. In the midland counties the fall was only 107 per cent. of the average. There was a slight deficiency of sunshine over the whole kingdom, except in the north of Scotland, where there was a slight excess. At Greenwich the mean temperature for the three months to the end of March was $42 \cdot 5^{\circ}$, which is $2 \cdot 5^{\circ}$ in excess of the average, and the temperature was above the normal on fifty-seven days out of the ninety. The aggregate rainfall was 6·92 in., which is 142 per cent. of the average, and is 2·05 in. above the normal. The duration of sunshine was 216 hours, which is an excess of 29 hours.

The first course of a series of lectures arranged by the National Academy of Sciences, Washington, under the William Ellery Hale foundation, is being delivered by Sir Ernest Rutherford, at the National Museum, Washington, on April 21 and 23. The series of lectures is to cover several years on the general subject of evolution, the intention being to present a clear outline of the broad features of inorganic and organic evolution in the light of recent research. The subjects of Sir Ernest Rutherford's lectures are the constitution of matter and the evolution of the elements. The second course in the evolution series will be given at the autumn meeting of the academy by Dr. W. W. Campbell, director of the Lick Observatory; and a distinguished European geologist will be invited to give the third course at the annual meeting of the academy next year. Taking the earth from the hands of the astronomer, he will show how its surface features have been altered in the process of time. Later lectures, preserving the continuity of the series, will then enter the field of organic evolution and illustrate the bearing of recent investigations in palæontology, zoology, and botany on the evolution of plant and animal life. The evolution of man will form the subject of another course, and the series will close with an account of the rise of the earliest civilisations, coming into touch with the modern times in the life of the Nile Valley. In all cases the lectures will be given by leading European and American investigators, whose personal researches have contributed largely towards the development of the fields of science which they represent.

The second reading of a Bill to prohibit experiments on dogs was carried in the House of Commons on Friday last, April 17, by a majority of forty-two, the voting being 122 for the second reading and 80 against. It was stated on behalf of the Government that an amendment will be moved in Committee to abolish the proposed prohibition and to allow experiments only in cases where no other animal but a dog is available for the purpose. The Bill was brought in by Sir F. Banbury, one of the members for the City of London. The motion for the second reading was seconded by Colonel Lockwood, member for the Epping Division of Essex. Mr. Rawlinson, Cambridge University, moved the rejection of the Bill; and the amendment was seconded by Sir P. Magnus, London University, and supported by Sir H. Craik, Glasgow, and Aberdeen Universities. Before the second reading was taken, a memorial signed by more than three hundred eminent physicians, surgeons, and other scientific investigators, protesting against the measure, was addressed to the Home Secretary. The memorial is in the following terms:—"We desire to express to you our strong conviction that the Dogs Protection Bill, which is put down for second reading on Friday, 17th inst., would inflict very severe injury, not only on medicine and surgery, but also on the study of the diseases of animals. We think that we have some right to ask you to oppose this attack on the advancement of medical science and practice; especially as the Final Report of the Royal Commission on Vivisection does not advise the prohibition of experiments on dogs. We are absolutely certain that such experiments are necessary for the complete study of many problems of physiology, pharmacology, and pathology."

The discovery of a prehistoric workshop floor, with flints, and other fragments, was incorrectly said in a note last week (p. 169) to have been made at St. Albans, instead of Ipswich, though the latter place was mentioned later in the paragraph.

In the *Times* of April 11 Mr. H. St. George Gray gives his final report of the results of excavations at Maumbury Rings, Dorchester. The great earthwork has now been investigated. In prehistoric times there existed an immense circular ditch, having a medial diameter of 169 ft. This was adapted by later Roman settlers for use as an amphitheatre. In some respects Maumbury resembles Avebury, and the fosse in both cases may have been intended to prevent animals and the ordinary public from trespassing on a spot reserved for ceremonies conducted by the privileged. The excavations now in progress at Avebury may result in strengthening a comparison between these two important prehistoric enclosures.

In part i., vol. xxxvi., of the Transactions of the Bristol and Gloucestershire Archæological Society for 1913, Miss I. M. Roper discusses the delineation of flowers in stone in Bristol Church architecture. Such carvings appear only sporadically in Anglo-Saxon work, as at Britford, near Salisbury, and on Acca's Cross at Hexham. But they become numerous at the close of the Norman period, from A.D. 1175 to A.D. 1200. The designs are naturally conventional, but display much appreciation of botanical forms. It is possible in some churches to recognise the campanula, trefoil, and vine-leaf. The magical use of the holy herb, now known as yellow avens or herb bennet, constantly appears. Such flower ornamentation appears on the tower of St. Mary Redcliffe, A.D. 1292, and in the choir of Bristol Cathedral, A.D. 1298–1332. In the latter the oak-leaf is a common subject, and we also find the maple, beech, ivy, and hawthorn. Among herbaceous plants may be recognised the yellow water-lily, white bryony, and the buttercup. Miss Roper identifies the familiar ball-flower type of ornament with the ripe fruit of the juniper. Excellent as most of the carving is, its best efforts naturally bear no more than a coarse resemblance of nature's handiwork.

We have received the first progress report of the Thompson-McFadden Pellagra Commission. It includes a study of the epidemiology of pellagra by Capt. Siler and Surgeon Garrison, in which it is stated that observations on the habitual use of the more common foodstuffs failed to discover any points of difference between pellagrins and non-pellagrins.

The Journal of the Royal Society of Arts for March, 1914 (vol. lxii., No. 3199) contains a paper by Prof. Bottomley on the bacterial treatment of peat. The raw peat is treated in three stages—first, the raw peat is moistened with a culture solution of the special "humating" bacteria, and the mass is kept at a constant temperature for a week or ten days; during this time the bacteria act on certain organic constituents of the peat, and gradually convert a large amount of the humic acid present into soluble humates; secondly, the "humating" bacteria having done their work are destroyed by sterilising the peat by live steam; thirdly, the sterilised peat is treated with a mixed culture of nitrogen-fixing organisms—*Azotobacter chroococcum* and *Bacillus radicicola*—and after a few days' incubation at 26° C. is ready for use. The material so obtained possesses astonishing fertilising properties, and extensive trials with satisfactory results have been carried out at Kew.

Bulletins No. 10A and 10B of the Eugenics Record Office contain a report of "the committee to study and to report on the best practical means of cutting off the defective germ plasm in the American population." The former of these discusses the scope of the committee's work, which indeed covers the whole of "negative" eugenics and extends beyond it. The first problem is, of course, to decide what is defective germ plasm and how it manifests itself in the life and character of the individual who bears it. The committee has gathered little fresh knowledge in this field, and their treatment of the questions involved is rather unsatisfactory. For example, the most conspicuous feature of their discussion on criminality is an elaborate classification of crimes, which has not the merit of being logical, since qualities such as "incorrigibility" and conditions such as "prostitution" are included in it, whereas a crime must necessarily be an act. Bulletin 10B is a more useful work, as it contains an account of the American Sterilisation Laws, and of Bills which have been brought forward in State legislatures for this end without reaching the statute-books. An excellent summary of the laws was communicated to the last Eugenics Congress by Mr. Van Wagenen, in the form of a preliminary report of the committee, but the report now under notice is much fuller, and contains, in addition to the items mentioned, a record of the legal proceedings which have arisen out of the laws.

The *Psychological Review* for March contains an interesting paper by E. K. Strong, illustrating the application of psychological experiment to problems of commercial interest. The special problem under investigation was the relative efficacy of the one-page advertisement in four months compared with two half-page advertisements every two months, and with four quarter-page advertisements every month. This problem involved the consideration of two distinct points: the effect of increase in the size of an advertisement and the effect of continued repetition of an advertisement on the reader's memory. The advertisements for the experiment were carefully chosen so that they were not likely to be seen save in the test; other suitable precautions were also taken. The 288 advertisements selected were divided by the experimenter into four sets corresponding to the four monthly issues of a magazine. The four sets were shown to the subjects at intervals of a month. One month later the subjects were tested, by their ability to select from an equal number of advertisements previously seen and unseen, as to their remembrance of what had been shown them. The writer concludes (1) that the value of space in advertising as affecting permanent impressions increases approximately as the square-root of the increase in area, (2) that when the interval of time between successive presentations is very long (a month), space used in advertising is more effective when used in a large advertisement than if presented in small advertisements repeated with greater frequency.

The twenty-seventh annual report of the Marine Biological Station at Port Erin records that the number of workers in 1913 was seventy-two, and that all the available work-places were fully utilised during the Easter vacation. Though some relief was obtained by converting part of a large apparatus-room into a laboratory for bio-chemistry, extension of the laboratory accommodation will evidently be required in the near future. Besides the usual work in the laboratory and the shore-collecting, the students attending the course during the Easter vacation had the advantage of demonstrations of oceanographic work on Prof. Herdman's S.Y. *Runa*. The work of the fish hatchery has proceeded as in previous years; more than seven and a half millions of plaice larvæ were hatched, taken out to sea, and liberated, and the difficult work of rearing young lobsters has been carried on with some success. The report records the captures (many of which have already been noticed in the columns of Nature) made during the cruise of the *Runa* in the Hebridean Sea in 1913; these include 259 species of Foraminifera, several new to Great Britain, a preliminary list of which is given by Messrs. Heron-Allen and Earland.

We have received the report of the Rugby School Natural History Society for 1913, in which the secretary takes a thoroughly optimistic view of the present position and future prospects of that body. An article on the architectural works of Robert Adam and the "Adelphi" affords much interesting reading.

According to a statement issued by the Smithsonian Institution, the nearly complete skeleton of a dwarf horned dinosaur (Ceratopsia) has been discovered recently in the Montana Cretaceous. The skull measures only 22 in. in length, against from 6 to 8, or even 9 ft., in the larger members of the group, the whole size of the new form being only about one-fourth that of the latter.

The most interesting item in vol. x., part 1, of the Records of the Indian Museum is the description by Dr. W. M. Tattersall, in an article on Indian brackish-water crustaceans of the family Mysidæ, of a new genus and species from Bombay, for which the name *Indomysis annandalei* is suggested. So distinct is the genus that its inclusion in the subfamily to which it is most nearly related involves a modification in the definition of that group. It is "distinguished by the combination of characters afforded by the unjointed antennal scale, the short entire quadrangular telson, and the form of the pleopods in the male."

AN important contribution to our knowledge of the zoology of the Austro-Malay Archipelago is made by the appearance in vol. xix. of *Bijdragen Tot de Dierkunde* of the full scientific results of Dr. L. F. de Beaufort's journey in that region during the years 1909 and 1910. As we learn from the introduction, by Dr. de Beaufort, the main object of the expedition was to collect the fresh-water fauna of Buru, Ceram, Waigeu, and other islands, and thus complete, so far as possible, the work initiated by Prof. Max Weber, who was the first to collect systematically the fishes and other members of the fresh-water fauna of Sumatra, Java, Celebes, and other Sunda islands. But collecting, although not indiscriminate, was by no means restricted to the rivers and lakes, as may be seen by reference to the list of contents, which comprises ten articles by specialists, including one, with a coloured plate, on the fishes by Dr. de Beaufort, with remarks on the zoogeography of the region.

THE aforesaid article by Dr. de Beaufort on the fishes of the eastern islands of the Austro-Malay Archipelago is supplemented by one in the same fasciculus on those of Celebes by Prof. Max Weber. This issue also contains the results of Dr. C. Kerbert's study of the various local forms of long-beaked echidnas of the genus Zaglossus (Proëchidna), to which reference has been made previously in NATURE. It is illustrated by a plate showing the marvellous similarity between the walking pose of these strange beasts and that of a giant land-tortoise.

AT the price of one penny, the London County Council has issued "A Handbook to the Collections Illustrating a Survey of the Animal Kingdom," in the Horniman Museum and Library, Forest Hill. Although the text conveys a large amount of information, it would have been better suited to its purpose if a larger use had been made of the vernacular and fewer technicalities employed. It would also have been well to avoid the misstatement (p. 58) that the lower teeth of a dog are equal in number to the upper; whilst the merest tyro in natural history ought to be aware that Sibbald's fin-whale (p. 71) does not belong to the same genus as the Greenland whale. It is, moreover, unnecessary to add to the brain-worry of students by introducing so-called orders, like Ancylopoda (p. 65), which have long since been abolished.

THE *Bulletin Hydrographique* of the International Council for the Study of the Sea for the year July, 1911, to June, 1912, records the hydrographical observations carried out in the North Sea and adjacent waters during the period named. The observations do not appear to have been carried out upon as extensive a scale as in former years, and a chart of surface salinities for the North Sea is only provided for one month, viz., May, 1912. The mean surface temperatures are more fully shown in a series of charts which give the surface isotherms for periods of ten days, three charts being given for each month. A number of sections showing the conditions in the North Sea below the surface are also provided, based chiefly on Scottish and English work. The Finnish and Danish investigators contribute the results of numerous gas analyses of sea-water, the measurements given referring to the amounts of oxygen present at different depths at certain stations in the Gulf of Finland, in the Belts and Kattegat, and at the Faroes.

THE fauna of the great Ringk bing Fjord, on the west coast of Jutland, in the neighbourhood of Holmsland, forms the subject of an elaborate memoir by Dr. A. C. Johansen, published at Copenhagen in the volume entitled "Mindeskrift for Japetus Steenstrup," 1913. The subject has been treated by several previous writers, notably by Rambusch, in his "Studier over Ringkøbing Fjord," published in 1900, while a large amount of literature relating to the fisheries has appeared. Of all these sources of information the author has availed himself to the full, especial interest attaching to the physical changes recorded as having taken place between the middle of the seventeenth and the middle of the nineteenth century.

AN important study in European geography was contributed to the *Bulletin international de l'Académie des Sciences de Cracovie* during 1912 by L. Sawicki, entitled "Beiträge zur Morphologie Siebenbürgens." The explanatory method is followed, and a broad view may be gained of the changes that have taken place in the eastern Carpathian mass since the coastal plain of the Pontian sea was uplifted and a consequent system of westward-running rivers was established on its slope. This system was greatly interfered with by volcanic outpourings and cone-building in the Hargitta region, and the present young gorges of the Maros and the Alt are due to the escape of water that was ponded back in a series of lakes, and thus kept for a time from flowing westward. The same author describes glacial landscapes in the Westbeskiden, where the somewhat feeble local ice has left more evidence in the way of cirques and moraine-barriers than has previously been observed.

THE ninth paper by Dr. E. van Rijckevorsel on the periodicity of secondary maxima and minima in meteorological phenomena appears in No. 16 of the *Mededeelingen en Verhandelingen* of the Royal Meteorological Institute of the Netherlands. As any subsequent papers on this subject will be continued in the same publication, a brief statement of some of the results hitherto arrived at is given in the present number. In the yearly march of temperature certain small maxima were found about every ten or eleven days, which were constant in time and space. These zigzag curves ("Zacken") were also shown to exist for air-pressure, rainfall, etc., with important modifications relating to the occurrence of maxima and minima in different seasons. The author assumes that these zigzags are only special cases in a whole series of small periodical variations, and he has undertaken the laborious task of investigating these variations in detail.

IN a recent number of the *Annalen der Physik* there appears an important paper by Prof. Quincke on "Electrische Schaumwände der Materie." The subject-matter is a continuation of the work which has been done on the structure of "foam" walls and chambers, but in particular he points out an analogy between these and the electrical "dust" figures, which he regards as being due to the formation of foam chambers by electrical emanations of positively or negatively charged particles. Ordinary foam chambers made by precipitation or other methods he regards as being of two kinds: (1) those formed quickly in viscous fluids, and which may take a variety of forms, (2) those formed slowly in less viscous fluids, and which consist of globular cells connected by tubes. When the charged knob of a Leyden jar is presented to a cake of resin, he supposes that an electrical emanation of charged particles is emitted, and these particles are attracted to the plate of resin. By their impact they melt the resin locally to form an oil-like substance which solidifies around the charged particle, and thus produces a "foam" chamber with electrified walls. These chambers are rendered visible by dusting with the usual mixture of red lead and sulphur. He regards those upon which the sulphur is deposited as being similar to type (1), and those upon which the red lead settles as being similar to type (2).

NEARLY all the optically-active carbon compounds that have been prepared hitherto have been substances of relatively complex composition. The two simplest, lactic acid, $CH_3.\mathbf{C}H(OH).CO_2H$, and *sec.*-butyl alcohol, $CH_3.\mathbf{C}H(OH).C_2H_5$, contain three and four carbon atoms respectively; in each case also three of the four radicles attached to the asymmetric carbon atom **C** are compound radicles, and only one (the hydrogen atom) is simple. Special interest attaches therefore to the two simple substances, ammonium *d*- and *l*-chloroiodomethanesulphonates,

$$\mathbf{C}HClI.SO_3.ONH_4,$$

which have been prepared and separated in an optically-active form by Prof. Pope and Mr. Read (Trans. Chem. Soc., 1914, vol. cv., p. 811). In these substances three of the radicles are simple, and only one is compound; none of the four radicles contains a carbon atom, and the percentage of carbon amounts to less than 5 per cent. The two acids were separated by fractional precipitation from the ammonium salts by the addition of brucine; after reconverting into the ammonium salt the dextro-acid gave the molecular rotation $[M]_{5461}+43^\circ$. The active material is remarkably stable; the optical activity is not changed by boiling alone or with acids or alkalis, or by heating with water in a sealed tube to 130–150°.

Engineering and the *Engineer* for April 17 contain articles dealing with electric power supply in London. Messrs. Merz and McLellan have investigated this subject recently, and have presented a report to the London County Council. Apart from traction stations there are seventy generating stations at present in London, containing 585 engines. The report states that there are practically only two ways of effecting important economies in electricity generation in London; first, to allow the extension of eight or ten of the best existing stations, and gradually to abandon all the others; secondly, to abandon all sites in or near the metropolitan area, and to concentrate the production of electricity for all purposes well outside. The primary distribution system throughout London should be standardised. Assuming all existing stations for the supply of light and power to be in the hands of one authority, the final conclusions are that it would pay to shut them all down, sell most of the plant, and generate all energy on sites down the river. Considering only the central area, it is estimated that the saving in working costs with this scheme would be about 18 per cent., or 170,000*l.* a year.

THE editor of the new quarterly, *Isis*, devoted to the history and organisation of science, asks us to say that the annual subscription is 30 francs per annum, and not 24 francs as stated in a note in NATURE of April 9 (p. 143).

A COPY has been received of the second supplement, 1911–13, to the catalogue of Lewis's Medical and Scientific Circulating Library, 136 Gower Street, London, W.C. A classified index of subjects, with the names of those authors who have written upon them, is included.

OUR ASTRONOMICAL COLUMN.

COMET 1914*a* (KRITZINGER). — The following ephemeris of comet 1914*a* (Kritzinger) is published by Prof. Kobold in *Astronomische Nachrichten*, No. 4727:—

12h. Berlin M.T.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
April 23	17 38 35	+8 45·2	9·5
24	42 30	9 40·7	
25	46 27	10 36·6	
26	50 25	11 32·7	9·4
27	54 23	12 29·0	
28	17 58 23	13 25·4	
29	18 2 24	14 21·9	
30	18 6 27	+15 18·3	9·3

THE VARIABLE 081041, −41° 3911, H.V. 3372.—Prof. E. C. Pickering communicates some interesting facts relative to the spectrum and magnitude of the star C. DM. −41° 3911, this star having previously been found by Mrs. Fleming to be peculiar, and also later independently by Miss Cannon. In identifying this object Miss Mackie has found that it is a variable, and in this paper the magnitudes are given for the period 1890 to 1912. The nature of the variation is indicated by a curve. Prof. Pickering describes the object as a very curious one. At first sight it might appear to be a variable star with a period of about twenty years, and varying from the eleventh to the fourteenth magnitude. He points out that ordinary variables of long period have a very different spectrum and undergo all their changes in less than two years. In this case the variations may prove to be irregular and to resemble those of the three stars of the class of R. Coronæ. The position of the star for 1900 is R.A. 8h. 10·8m., and declination −41° 24′, and additional observations of both its magnitude and spectrum are required to settle the peculiarity above mentioned.

THE SOLAR CONSTANT OF RADIATION.—No one interested in this subject should fail to read an address delivered before the Philosophical Society of Washington by Prof. C. G. Abbot, the retiring president, and reported at length in *Science* of March 6. The address forms a valuable aperçu of the subject from Herschel's pioneer actinometric observations down to the experiments made late last summer under the joint auspices of the Smithsonian Institution and the U.S. Weather Bureau on the employment of *ballons-sondes* in pyrheliometric investigation. With regard to the solar constant, the mean value of 690 measurements made in connection with the Astrophysical Observatory of the Smithsonian Institution during the period 1902–13 is stated to be 1·933 calories per sq. cm. a minute, a value which is probably accurate to 1 per cent. It will be noted that this period covers one sun-spot cycle, and it is also stated that the Mount Wilson measures indicate that the solar radiation is more intense at spot maximum than at minimum, the sun thus showing affinity with variable stars of the *o*-Ceti type.

THE ACTION OF GRAVITY ON GASEOUS MIXTURES.—M. G. Gouy, in a recent communication to the Paris Academy of Sciences (*Comptes rendus*, vol. clviii., pp. 664–8) extends to the terrestrial atmosphere his researches on gaseous mixtures which during 1912 led him to the conclusion that pressure could not be the cause of the general displacement of the Fraunhofer lines towards the red. We may direct attention to the fact that the suggestion he then made that perhaps the explanation of this phenomenon would be found in the Doppler effect has received striking confirmation on purely spectroscopic grounds very recently in the work of Mr. Evershed (NATURE, March 19, p. 69). The present paper affords a mathematical demonstration of the impossibility of stratification according to density by the action of gravity on the gases in the earth's atmosphere where the pressure exceeds that of a Crookes tube as the final result indicates that under these conditions the effect of gravity on the composition of the air is too slow to produce sensible effects.

GROWTH AND CULTIVATION OF HOPS.[1]

THE close attention which is being given in many foreign countries to the scientific study of plants of economic importance is evidenced in the two reports on the hop lately published by Dr. J. Schmidt. Although the cultivation of hops in Denmark is at present restricted to about 100 acres, Dr. Schmidt, of the Carlsberg Laboratory, Copenhagen, was recently commissioned to visit this and other countries with the object of collecting information on the most modern methods of cultivation, and also to collect data and material likely to prove of value in the work of breeding improved varieties of hops for cultivation in Denmark. In 1910 the physiological department of the Carlsberg Laboratory began a series of investigations on the hop plant (*Humulus lupulus*, L.), with a view of obtaining information of theoretical and practical interest regarding this plant. These reports by Dr. Schmidt are the first-fruits of this work.

In the first report, the growth in length of the stem and its diurnal periodicity is dealt with. One of the first problems for investigation that presented itself was to ascertain if the foreign varieties of hops obtained from southern regions which are being grown in the experimental garden attached to the Carlsberg Laboratory have a different rate of growth in the northern climate of Denmark from the wild-growing plant of that country. In the course of making these investigations, which are not yet concluded, the experiments detailed in this first report were made.

Dr. Schmidt was at the outset inclined to the belief—a belief, by the way, which is firmly held by the practical hop-growers of Kent—that the growth of the hop stem, or "bine," would be strongest during the night. Observations on a number of plants soon showed, however, that the reverse is the case. The least growth took place during the six hours 9 p.m. to 3 a.m., which proved that darkness was not the dominant factor of growth. It might have been expected that the growth-promoting factor of darkness would first show itself as an "after-influence," and that consequently the greatest growth would be during the following morning period, 3 a.m. to 9 a.m. It was found, however, that the strongest growth occurred during the period 3 p.m. to 9 p.m., immediately preceding the darkest period, the value for the rate of growth increasing evenly from the minimum of the latter period to the maximum of the afternoon period.

In the two main series of experiments, which were carried out in 1911 from the end of April, to the end of June, and in 1912 during July, the plants, growing in an unheated glasshouse, were kept as far as possible under natural conditions. The measurements were made continuously at 6 o'clock in the morning, 12 o'clock noon, 6 o'clock in the afternoon, and at 12 o'clock at night. The diurnal oscillations of temperature were followed by means of a thermograph.

Further experiments made seemed to show conclusively that the influence of the temperature on the rate of growth under natural conditions predominates over the influence of humidity; as the author remarks, "the growth-promoting power, which high humidity is known to have under natural conditions, is 'covered' by the influence of the temperature, so that it appears as if only the temperature was of any importance for the rate of growth of hop-stems."

The results of the investigations are summed up as follows:—"The growth in length of hop-stems under natural conditions has a very distinct diurnal period, the rate of growth being smallest during the night, greatest during the day. This periodicity is determined by outer factors, among which the temperature has such a predominant influence that under natural conditions it determines the rate of growth."

The second report deals with investigations into the rotational movement of the hop-stem. In experiments with vigorous three-year-old hop-plants, in an unheated glasshouse, the stems were found to show, during May and June, a rotational movement amounting on an average for one to two weeks' observations to about 120° an hour, or one-third of the rate of the minute hand of the clock. The following table records the facts observed with two hop-plants, one (No. 14) obtained from Germany, the other (No. 36) from England:—

	No. of whole days under observation	Total rotation in degrees	No. of turns	No. of turns in 24 hours (Average)	No. of degrees an hour (Average)
Plant No. 14		°			°
Shoot *a* ...	9 ...	24865 ...	69 ...	7·7 ...	115
,, *b* ...	9 ...	25875 ...	72 ...	8·0 ...	120
,, *c* ...	11 ...	29810 ...	83 ...	7·5 ...	113
Plant No. 36	13 ...	37600 ...	104 ...	8·0 ...	120

The rotational movement proved to have a very distinct daily periodicity, the rate being greatest during the day, least at night. This daily periodicity is determined by external factors, among which the temperature is of such dominating importance that

[1] Johs. Schmidt: (1) "The Growth in Length of Hop-stems and its Diurnal Periodicity" (*Comptes rendus des travaux du Laboratoire de Carlsberg*, 10me vol., 2me livraison, 1913).
Idem. (2) "The Rotational Movement of Hop-stems and its Diurnal Periodicity" (*l.c.*, 3me livraison, 1913).

its variation under natural conditions is determinative for the rate of rotation.

A graphic comparison of the fluctuations in the rate of rotation and degree of humidity showed that there was no connection between them under the (natural) conditions prevailing when the observations were carried out.

From some laboratory experiments with pot-plants it appeared that the rotational movement is not different, or at any rate not essentially different, in the dark and in scattered daylight.

An endeavour was made, with the minimum temperature (which "lies in the neighbourhood of 4°") as starting point, to obtain an expression of the relative quantities of heat, which were of importance for the rate of rotation. The numbers obtained, which are called "active quantities of heat," show that there is a very complete agreement between fluctuations in these and in the rate of rotation, the fluctuations showing a perfect synchronisation under the conditions observed.

Comparative experiments with twining bean-plants, and with *Lonicera periclymenum*, L., showed that a similar daily periodicity in the growth in length and rate of rotation of the stem occurred and that temperature is here also the determining factor. The author concludes by remarking:—"It is probable that the growth movements in many plants living under climatic conditions such as ours, where great temperature fluctuations occur in a diurnal period, have a diurnal periodicity which follows that of the temperature." E. S. S.

EDUCATION IN INDIA.[1]

IN the two substantial volumes before us Mr. Sharp gives an exceedingly able and comprehensive summary of the educational work done in India in the period 1907–12. The value of this record is enhanced by the inclusion of a Resolution of the Government of India dated February 21, 1913, summarising its educational policy, and forming a masterly exposition of its aims. A member of the Council of the Government of India has now been appointed with special charge of education, and the first incumbent of the post is Sir Harcourt Butler, who is to be congratulated on this very able summary.

The impression gained from the volumes is that education in India has now entered on a new and hopeful page of its history, for the progress made in the past five or ten years has been very great. Every effort is being made not only to widen the area of education, but also greatly to improve its methods, while in the forefront the formation of the character of the pupils is rightly insisted on. There are also clear signs that in the future efforts will be made to raise the status of those engaged in education, and to make their position such that the post of a teacher will be much sought after, and not taken as a last resource, as is largely the case at the present time.

India is sometimes pictured as a single country, but it really shows far greater complexities in education than Europe itself. It is computed that there are about thirty-eight million children of school-going age in the area dealt with in this report, while there are only 176,225 educational institutions of all classes, and in these six and three-quarter million pupils are under instruction. Almost all of these are boys, and the most trustworthy figures show that in 1911–12 for every mille of population of school-going age there were 268 boys and 47 girls under education. Five years previously these figures were 227 and 32 respectively. This really represents rather rapid progress, though compared with civilised Europe, India is still very far behind in the education of its masses.

Until recent years more attention was paid to the development of higher education than to that of the masses, but this has been largely changed during the past ten years, and now primary education is being largely fostered.

The type of higher education at first introduced was unpractical, largely literary, and tended to superficial knowledge, and in a large proportion of the students it did not fit them for their work in after life. Various efforts at reform were made, but the first effective movement came from Lord Curzon when Viceroy of India, who in 1901 summoned a representative conference which dealt with the whole subject of education from the university down to the primary stage. Numerous far-reaching reforms were formulated, and the history of many of the reforms is illustrated in the work under review.

One of the results of the conference was the Universities Act of 1904, under which regulations were framed, which came into force about the beginning of the period which is dealt with in Mr. Sharp's volumes. This Act was most bitterly opposed, but it is now admitted that it has produced a general and most important improvement in both university and secondary education, for some of the universities in India have large powers over the secondary schools which prepare candidates for university education, as they regulate the courses of study and even have powers of inspection, etc. It is probably true to say more progress has been made during these five years in improving and consolidating secondary and university education than in any previous quinquennium, for institutions which were working inefficiently have ceased to be recognised and have disappeared, while others have been helped and made more efficient. Indeed, the report indicates there have been great improvements in the courses of instruction in colleges and schools, also in thoroughness of study, in the more practical requirements in the study of, and examination in, science subjects, and finally in considerable improvements in discipline and in the formation of character, due to the students being compelled to live in recognised hostels (on which much money has been spent) or in messes under proper supervision.

The reforms due to the Educational Congress of 1901 included a large extension and improvement in primary education and its more efficient inspection, and a recommendation that greater attention should be paid to the teaching in and through the vernaculars. Both these reforms have made large progress during the past five years, and are undoubtedly leading to sounder education. Attention is now also being paid to manual training and nature-study. An endeavour to obtain more trained teachers in all stages of education is occupying considerable thought, and efforts are being made to effect this, but when it is stated that there are 215,518 teachers in India, who all ought to be trained, the magnitude of the problem is seen to be almost overwhelming.

Increased attention has also been given to female education, which, owing to the peculiar difficulties arising from the customs of the people themselves, has always been, and still is, in a very backward condition. As the result of this increased attention during the five years, the number of girls at school has increased by 47·7 per cent., but even this large increase only brings up the percentage of girls at school to the population of girls of school-going age to 5·1 per cent. Strenuous efforts are being made to

[1] Progress of Education in India in 1907–12. Sixth Quinquennial Review, by H. Sharp. Vol. i., pp. xvii+284+index; vol. ii., pp. 292. (Calcutta: Superintendent Government Printing, India, 1914.) Prices, vol. i., 6*s.*; vol. ii., 3*s.*

render female education more popular and effective, and on their success the future progress of India in a large measure depends.

It is remarked that during the five years a very great change has taken place in the feeling of the population of India towards education, and it is now much more popular than it was. Indeed there was a proposal to make primary education compulsory in India generally, but this has been negatived, though it is being adopted in Baroda.

Much more money is now being spent on education. In 1907 the cost of education was said to be 559 lakhs of rupees, and in 1912 it had risen to 786 lakhs, of which the Government contributed a very large proportion. With this liberal policy there is no doubt very rapid progress will be made, for the cost of educating individual pupils in India is still small. Thus the annual cost of a primary-school pupil is about six shillings, of a secondary-school pupil about *1l. 12s.*, and of a pupil reading for a university degree about *11l. 5s.*, and yet with these small individual sums a fair training is being given in the case of university and secondary education, though the primary education is still very defective.

THE MOUNT WILSON SOLAR OBSERVATORY.

IT is always difficult to condense in a few lines the essence of the work accomplished during a year at the Mount Wilson Solar Observatory. The report for the past year, just issued by the director, is a concentrated essence by itself, and as it covers forty-five pages the difficulty of the task will at once be grasped. The director commences the report by summarising the principal results obtained during the year, and the brief paragraphs which compose this summary, each of which is practically restricted to an important piece of research work, number no fewer than *seventy-two*. Space does not permit one to refer even to the more important of these, but many have already received notice from time to time in our astronomical column, and are therefore familiar to our astronomical readers. Perhaps the most important result is that concerning the magnetism of the sun. Observations of the Zeeman effect at various solar latitudes have indicated that the sun is a magnet, and that the magnetic poles are at or near the poles of rotation. Further, the polarity of the sun corresponds with that of the earth, a conclusion, as the director, Prof. Hale, remarks, which may prove to have an important bearing on theories of terrestrial magnetism. The first approximate value for the vertical intensity of the sun's general field at the poles is given as 50 gausses, which is about one-hundredth of the intensity of the most powerful sun-spot fields, and about eighty times that of the earth's field.

One of the most interesting items usually associated with these reports is the work of construction in hand, and this report shows an astonishing amount of work in progress. The fact that the 100-in. disc has been proved to be serviceable for a reflecting telescope has given rise to a great increase of activity. The grinding of the mirror and the 60-in. plane mirror for testing it have been pressed forward, and the requirement for larger shop tools necessitated by the construction of many parts of the 100-in. telescope mounting and the auxiliary instruments to be used with it have even demanded an increase in the already large shop floor-space. The work involved in the preparation of the foundations for this telescope and of the building and the eventual transport of the instrument to the mountain-top has necessitated the adoption of especially powerful motor trucks in place of the mule teams.

Other important work in hand is the construction of a large ruling-machine, embodying the general principles of Rowland's successful ruling-machines. An idea of the accuracy attained after the grinding and polishing of the screw will be gathered from the statement that no periodic errors were found greater than 0·000001 in., and no appreciable error of run could be detected. The maximum error in the teeth of the wormgear did not exceed 0·001 in., a quantity too small to produce appreciable ghosts.

To gain a more complete insight into the contents of the report the reader must be referred to the report itself. The fact that such rapid advances are being made in both solar and stellar physics is due to the happy combination of an energetic and able director, a keen and active staff, a good observing site, and an annual grant (for 1913) of 33,126*l.* for construction, investigations and maintenance.

[1] Annual report of the director of the Mount Wilson Solar Observatory 1913. Carnegie Institution of Washington.

MARINE INVESTIGATIONS.

THE report on the Danish Oceanographical Expeditions, 1908–10, to the Mediterranean and Adjacent Seas, under the superintendence of Johs. Schmidt, No. 2, contains two memoirs, one by Dr. Kyle, on flat fishes, and one by Dr. Schmidt, on experiments with drift-bottles. Dr. Kyle's paper is an important contribution, and deals with the following genera in a very comprehensive way :—Arnoglossus, Bothus, Solea, and Symphurus. The much disputed question as to the number of species of Arnoglossus occurring in European seas is very elaborately discussed, and Dr. Kyle's conclusions differ in several respects from those of previous authors. He recognises five species, the specific names being used, however, in a different sense from that which has been adopted by recent writers on the subject. The species are *Arnoglossus grohmanni*, Bonap., non auctorum, *A. thori*, nov. nom., *A. laterna*, Will., *A. imperialis*, Raf., and *A. rüppelli*, Cocco. Of these *A. thori* is the species which has generally been called in this country *A. grohmanni*. Dr. Kyle discusses not only the adult characters, but also the larval and post-larval stages of this genus and of the other genera of which he treats. The paper is well illustrated with text figures and plates, and will be of the greatest value to future workers. An excellent bibliography of the subject is added. Dr. Schmidt's experiments with drift-bottles show that there is an easterly drift of the surface water from the entrance of the Mediterranean, especially along the north coast of Africa, so that water from the Atlantic is being constantly carried into the Mediterranean. The velocity of this drift may reach eighteen to twenty miles a day.

The Central Bureau of the International Council for the Study of the Sea has issued vol. xvii. A of the "Rapports et Procès-verbaux des Réunions" (English edition), which contains the first part of Prof. Heincke's long-delayed general report upon the investigations on the plaice. This part of the report is confined almost exclusively to a discussion of the statistics obtained from commercial fishing vessels, and is further limited in scope by the fact that the English statistics are alone considered. The report is, in fact, little more than a renewed attempt to discuss the conclusions to be derived from these English statistics, matters which had already been dealt with by the officers of the Board of Agriculture and Fisheries. It is doubtful whether Prof. Heincke's methods of dealing with the statistics are in any way an improvement upon those followed in this country, and, probably from want of adequate trained assistance, it seems clear that the work has not been carried out with that accuracy of detail which is, we believe, attained by the statistical department of the English Board. In this connection Prof. Heincke states (p. 66):—"The appendix to this report contains a number of these tables drawn up by me from the English measurements. Close inspection will show, that here and there inaccuracies and errors have crept in during the preparation of the tables. Thus, in the case of large numbers which are the sum of many measurements, smaller or larger differences may be present between the English data and my tables. These small discrepancies will perhaps be excused, when the enormous amount of calculating work is considered; I do not believe that any essential error is present, which might lead to erroneous conclusions." In the opinion of the writer of this note there can be no excuse for a slovenly and inaccurate treatment of statistical data, and figures should not be published until errors such as those alluded to by Prof. Heincke have been eliminated.

SURFACE COMBUSTION.[1]

During his researches upon flame,[2] Sir Humphry Davy discovered, in 1817, that the constituents of a combustible mixture will combine slowly below the ignition temperature; this led him to inquire whether, seeing that the temperatures of flames far exceed those at which solids become incandescent, a metallic wire can be maintained at incandescence by the combination of gases at its surface, without actual flame. He thereupon tried the effect of introducing a warm platinum wire into a jar containing a mixture of coal-gas and air rendered non-explosive by an excess of the combustible constituents; the wire immediately became red hot, and continued so until nearly the whole of the oxygen had disappeared.

During the twenty years which followed Davy's discovery, several distinguished chemists (William Henry and Thomas Graham in this country, but more particularly Dulong and Thénard, and independently Döbereiner in France) experimented upon the slow combination of gases at temperatures below the ignition point, in contact with hot solids, whereby it was established (1) that hot solids, and pre-eminently metals of the platinum group, have the power of inducing gaseous combustion at relatively low temperatures; and (2) that hydrogen is, of all combustible gases, the most susceptible to this action.

The mechanism of this induced slow surface combustion formed the subject of a celebrated controversy between Faraday and De la Rive in 1834–5. De la Rive held the view that it consists essentially in a series of rapidly alternating oxidations and reductions of the surface; Faraday, on the other hand, contended that the function of the surface is to condense both the oxygen and the combustible gas, thus producing in the surface layers a condition comparable to that of high pressure. But, owing to lack of crucial experiments, no satisfactory theory of the phenomenon could be evolved, nor, with the exception of the famous "Döbereiner lamp," was there any practical outcome of this early work. In 1836 interest in the subject suddenly dropped, and was not revived for half a century.

Meanwhile, the researches of Deville upon the dissociation of steam and carbon dioxide at high temperatures led to the notion, which was strongly upheld by the late Frederick Siemens, that inasmuch as incandescent surfaces promote dissociation, they must necessarily hinder combustion. This, of course, is fallacious; we now recognise that if, as Deville proved, an incandescent surface accelerates the dissociation of steam, it must, according to a principle enunciated by Ostwald, of necessity accelerate the combination of oxygen and hydrogen in like degree, provided always that the surface remains chemically unaltered.

A notable demonstration of the possibility of realising a flameless incandescent surface combustion in contact with metals other than those of the platinum group was given by Thomas Fletcher in a lecture at the Manchester Technical School so far back as 1887.[3] He injected a mixture of gas and air on to a large ball of iron wire, flame being used at first in order to heat the wire to the temperature necessary to induce a continuous surface combustion; on extinguishing the flame, by momentarily stopping the gaseous mixture, the combustion continued without any flame, but with an enormous increase of temperature. Fletcher grasped three important points, namely, (1) that "this invisible flameless combustion is only possible under certain conditions"; (2) "that the combustible mixture shall come into absolute contact with a substance at high temperature . . ."; and (3) that "in the absence of a solid substance at a high temperature, it is impossible to cause combustion without flame"; but, so far as I am aware, he did not follow up the matter beyond this point, either in its theoretical aspects or practical applications, and his work had but little influence upon contemporary opinion or practice.

My own investigations upon surface combustion began in 1902 with a systematic attempt to elucidate the factors operative in the slow combination of hydrogen and of carbon monoxide in contact with various hot surfaces (*e.g.* porcelain, fire-clay, magnesia, platinum, gold, silver, copper, and nickel oxides, etc.) at temperatures below 500°.[4] Into the details of these earlier experiments, which preceded and led up to the technical developments about which I shall speak later, I do not propose to enter; it will be sufficient for my present purpose if I say that it was proved beyond all question:—(1) That the power of accelerating gaseous combustion is possessed by *all* surfaces at temperatures below the ignition point in varying degrees, dependent upon their chemical characters and physical texture; (2) that such an accelerated surface combustion is dependent upon an absorption of the combustible gas, and probably also of the oxygen, by the surface, whereby it becomes "activated" (probably ionised) by association with the surface; and (3) that the surface itself becomes electrically charged during the process. Finally, certain important differences between homogeneous combustion in ordinary flames and heterogeneous combustion in contact with a hot surface from a chemical point of view were established, so that there can be no longer any doubt as to the reality of the phenomenon.[4]

If hot surfaces possess the power of accelerating gaseous combustion at temperatures below, or in the neighbourhood of, the ignition point, the same power must also be manifested in even a greater degree at higher temperatures, and especially so when the surface itself becomes incandescent. Indeed, there are experimental grounds for the belief that not only does the accelerating influence of the surface rapidly increase with the temperature, but also that the differences between the catalysing powers of various surfaces, which at low temperatures are often considerable, diminish with ascending temperatures until at bright incandescence they practically disappear.

Such considerations as I have thus briefly explained

[1] From a discourse delivered at the Royal Institution on Friday, February 27, by Prof. W. A. Bone, F.R.S.

[2] Collected Works, vol. vi., p. 8.

[3] Journal of Gas Lighting, 1887, i, p. 168.

[4] Bone and Wheeler, Phil. Trans. Roy. Soc., 1906 (A. 206, pp. 1–67), also further (unpublished) results (1905–12) in collaboration with Messrs. G. W. Andrew, A. Forshaw, and H. Hartley, which are summarised in *Berichte der Deutschen Chem. Ges.*, 1913.

convinced me some years ago that if an explosive gaseous mixture be either injected on to or forced through the interstices of a porous refractory incandescent solid under certain conditions, which will be hereafter explained, a greatly accelerated combustion would take place within the interstices or pores, or, in other words, within the boundary layers between the gaseous and solid phases wherever these may be in contact—and the heat developed by this intensified combustion would maintain the surface in a state of incandescence *without any development of flame*, thus realising the conception of *flameless incandescent surface combustion*, as a means of greatly increasing the general efficiency of heating operations wherever it can be conveniently applied.

There are critics who, whilst admitting the accelerating influence of an incandescent surface upon gaseous combustion, are sceptical about the process being really flameless. The force of such objections largely disappear when we get into close quarters with the phenomenon, and realise how extremely slow a transaction flame combustion really is when considered in terms of molecular time. Take, for example, the case of such a quick-burning mixture as electrolytic gas ($2H_2+O_2$). When this is ignited at atmospheric pressure, the flame is initially propagated by conduction with a uniform slow velocity of 20 metres a second, and during this initial period of "*inflammation*," the total duration of chemical change in each successive layer is something like the order of 1/50 second, an interval of at least one hundred million times as long as the average interval between successive molecular collisions in the gas. Even after "*detonation*" has been set up in the mixture, when the combustion is propagated from layer to layer as a wave of adiabatic compression, at a velocity of 2820 metres a second, the total duration of chemical change is still of the order of 1/5000 or 1/10,000 second, or about a million times as long as the interval between successive molecular collisions.

The New Processes of Incandescent Surface Combustion.

Leaving the theoretical aspects of the subject, I will now describe some of the more important features of two processes of incandescent surface combustion evolved at the works of Messrs. Wilsons and Mathiesons, Ltd., in Leeds, under my direction, with the assistance of Mr. C. D. McCourt, in which a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion (or with air in slight excess thereof), is caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into radiant form. The advantages claimed for the new system, now known as the "Bonecourt" system, are:—(1) The combustion is greatly accelerated by the incandescent surface, and, if so desired, may be concentrated just where the heat is required; (2) the combustion is perfect with a minimum excess of air; (3) the attainment of very high temperatures is possible without the aid of elaborate regenerative devices; and (4) owing to the large amount of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is very rapid. These advantages are (as I believe) so uniquely combined in the new system that the resultant heating effect is, for many important purposes not only pre-eminently economical, but also easy of control.

Diaphragm Heating and its Applications.

In the first process the homogeneous mixture of gas and air is allowed to flow under slight pressure through a porous diaphragm of refractory material from a suitable feeding chamber, and is caused to burn without flame at the surface of exit, which is thereby maintained in a state of red-hot incandescence. The diaphragm is composed of granules of firebrick, or other material, bound together into a coherent block by suitable means; the porosity of the diaphragm is graded to suit the particular kind of gas for which it is to be used. The diaphragm is mounted in a suitable casing, the space enclosed between the back of the casing and the diaphragm constituting a convenient feeding-chamber for the gaseous mixture which is introduced at the back. Such a mixture may be obtained in either of two ways, namely, (1) by means of suitable connections through a Y-piece with separate supplies of low pressure gas and air (2 or 3 in. W.G. is sufficient), or (2) by means of an "injector" arrangement connected with a supply of gas at a pressure of 1 to 2 lb. per sq. in.; the gas in this case draws in its own air from the atmosphere in sufficient quantity for complete combustion, the proportions of gas and air being easily regulated by a simple device.

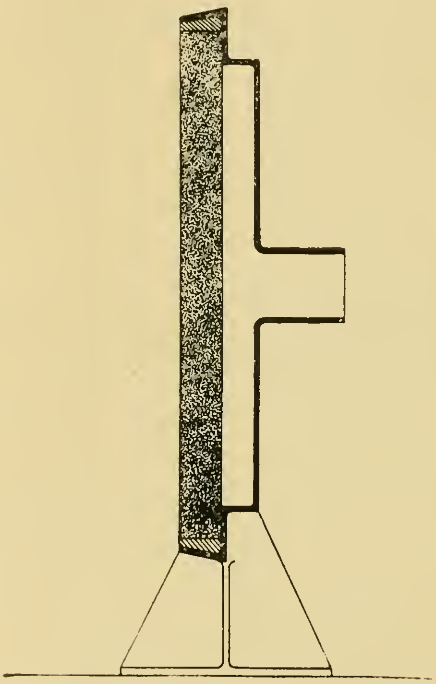

FIG. 1.—Diaphragm.

We will now start up a diaphragm (Fig. 1). Gas is first of all turned on and ignited as it issues at the surface; air is then gradually added until a fully aerated mixture is obtained. The flame soon becomes non-luminous, and diminishes in size; a moment later, it retreats on to the surface of the diaphragm, which at once assumes a bluish appearance; soon, however, the granules at the surface attain an incipient red heat, producing a curious mottled effect; finally, the whole of the surface layer of granules becomes red-hot, and an accelerated "surface combustion" comes into play. All signs of flame disappear, and there remains an intensely glowing surface throwing out a genial radiant heat which can be steadily maintained for as long as required.

Whilst the diaphragm is in operation before you, I may point out some of the more striking features of the phenomenon which it presents. First, the actual combustion is confined within a very thin layer—⅛ to

$\frac{1}{4}$ in. only—immediately below the surface, and no heat is developed in any other part of the apparatus. Kindly observe that while the front of the diaphragm is intensely hot, the back of the apparatus is so cold that I can lay my hand on it. Secondly, the combustion of the gas, although confined within such narrow limits, is perfect, for when once the relative proportions of gas and air have been properly adjusted, no trace of unburnt gas escapes from the surface. Thirdly, the temperature at the surface of the diaphragm can be instantly varied at will by merely altering the rate of feeding of the gaseous mixture; there is practically no lag in the temperature response, a circumstance of great importance in operations where a fine regulation of heat is required. Fourthly, a plane diaphragm such as this may be used in any position, *i.e.* at any desired angle between the horizontal and vertical planes. Fifthly, the diaphragm method is amenable to a variety of combustible gases —coal or coke oven gas (either undiluted or admixed with water gas), natural gas, petrol-air gas, carburetted water gas are all well suited in cases where unimpeded radiation is required. Finally, the incandescence in no way depends upon the external atmosphere. When once the diaphragm has become incandescent, and the proportions of air and gas supplied in the mixing chamber at the back have been properly adjusted, the surface will maintain its incandescence unimpaired, even in an atmosphere of carbon dioxide.

I need scarcely point out to you the many obvious purposes, domestic and industrial, to which "diaphragm heating"[2] may be applied. In the domestic line the boiling of water, grilling, roasting, and toasting are at once suggested, and although the best existing types of gas fires are thoroughly hygienic and efficient, I think that the diaphragm may come in for the heating of apartments; at any rate experiments are being carried out in that direction.

Incandescent Surface Combustion in a Bed of Refractory Granular Material.

The second process is applicable to all kinds of gaseous or vapourised fuels; it consists essentially in injecting, through a suitable orifice at a speed greater than the velocity of back-firing, an explosive mixture of gas (or vapour) and air in their combining proportions into a bed of incandescent granular refractory material which is disposed around or in proximity to the body to be heated (Fig. 2).

This process is capable of adaptation to all kinds of furnace operations, as, for example, to the heating of crucibles, muffles, retorts, and to annealing and forging furnaces generally. Moreover, it is not essential that the bed of refractory material should be very deep; indeed a quite shallow bed suffices to complete the combustion. Neither is it necessary that the bed shall be disposed *around* the vessel or chamber to be heated; for if contact with the burnt products is not objectionable, a shallow bed may be arranged *within* the heating chamber itself; or the refractory material may be equally well packed into tubes, or the like, traversing the substance or medium to be heated. The last-named modification is, as we shall see later, specially important in relation to steam-raising in multitubular boilers.

By means of this process much higher temperatures are attainable with a given gas than by the ordinary methods of flame combustion without a regenerative system, and, as a matter of fact, we have found that with any gas of high calorific intensity (such as coal gas, water gas, or natural gas) the upper practicable temperature limit is determined by the refractoriness of the material composing the chamber to be heated (*i.e.* the muffle or crucible) rather than by the possibilities of the actual combustion itself. When I tell you that in a crucible fired by coal gas on this system we have melted Seger-cone No. 39, which according to the latest determination of the German Reichsanstahlt melts at 1880° C. (3416° F.), and also that we can easily melt platinum, you will appreciate the possibilities of the method in regard to high temperatures with gas-fired furnaces.

Surface Combustion as Applied to Steam Raising.

I now come to an important application of the new process to the raising of steam in multitubular boilers; not that the application of surface combustion is limited to boilers of the multitubular type, but because our investigations have so far been principally made with these.

Our first experiments in Leeds were made with a single steel tube 3 ft. in length and 3 in. in diameter, packed with fragments of granular refractory material, meshed to a proper size, and fitted at one end with a fire-clay plug, through which was bored a circular hole, $\frac{3}{4}$ in. in diameter, for the admission of the explosive mixture of gas and air at a speed greater than that of back-firing. The tube was fitted into an open trough, in which water could be evaporated at atmospheric pressure.

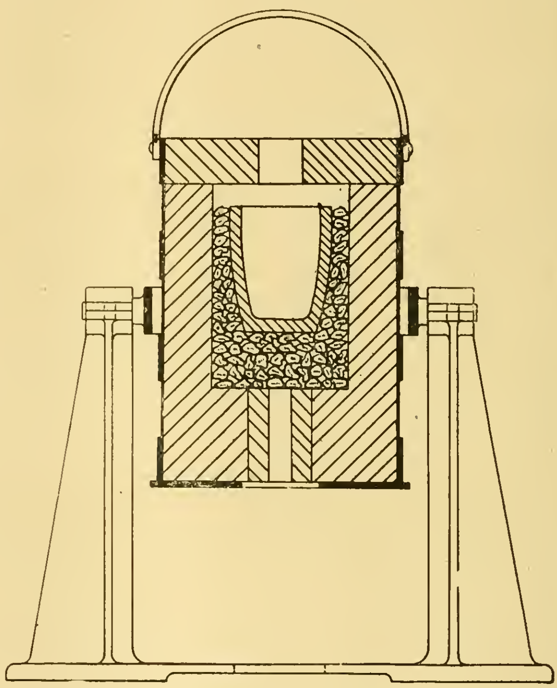

FIG. 2.—Crucible furnace.

Such a tube may be appropriately termed the fundamental unit of our boiler system, because boilers of almost any size may be constructed merely by multiplying the single tube, and as each tube is, so to speak, an independent fire or unit, the efficiency of the whole is that of the single tube, or, in other words, the efficiency of the whole boiler is independent of the number of tubes fired.

Experimenting with such a tube, it was found possible to turn completely a mixture of 100 cu. ft. of coal gas plus 550 cu. ft. of air an hour, and to evaporate about 100 lb. of water from and at 100° C. (212° F.) an hour (20 to 22 lb. per sq. ft. of heating surface), the products leaving the further end of the tube at practically 200° C. This meant the transmission to the water of 88 per cent. of the net heat developed by the combustion, and an evaporation per sq. ft. of heating surface nearly twice that of an express locomotive boiler. The combustion of the gas was completed within 4 or 5 in. of the point where it entered the tube, whilst the temperature of the products leaving the tube was about 200° C. Of the total evaporation, no less than 70 per cent. occurred over the first linear foot of the tube, 22 per cent. over the second foot, and only 8 per cent. over the last foot. This points to a very effective "radiation" transmission from the incandescent granular material in the first third of the tube, where the zone of active combustion is located, although it should be remarked that the *loci* of actual contact between the incandescent material and the walls of the tube are so rapidly cooled by the transmission of heat to the water on the other side that they never attain a temperature even approaching red heat. The granular material in the remaining two-thirds of the tube serves to baffle the hot products of combustion, and to make them repeatedly impinge with high velocity against the walls of the tube, thus materially accelerating their cooling, and either preventing or minimising the formation of the feebly-conducting stationary film of relatively cold gases which in ordinary boiler practice clings to the tube walls, seriously impairing the heat transmission.

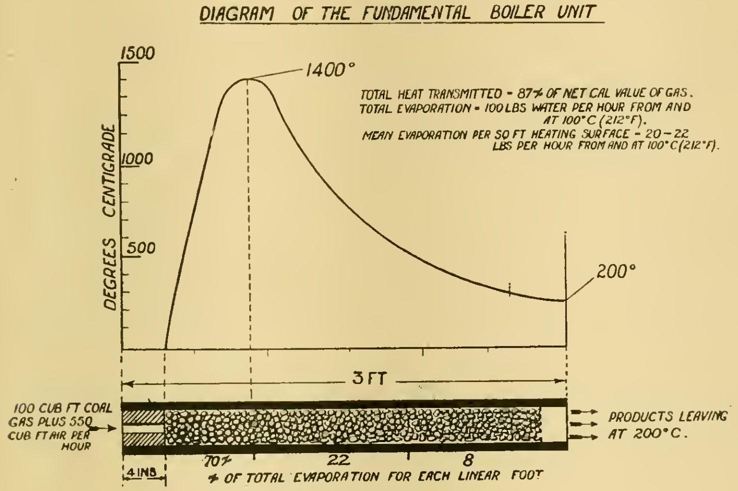

Fig. 3.—Fundamental boiler unit.

Having thus satisfied ourselves of the efficiency of the fundamental unit as an evaporator, we proceeded to construct our first experimental boiler, made up of ten tubes, each 3 ft. long and 3 in. in diameter, fixed horizontally in a cylindrical steel shell capable of withstanding a pressure of more than 200 lb. per sq. in. The gaseous mixture was forced through the tubes under pressure from a special feeding chamber attached to the front plate of the boiler; the products of combustion, after leaving the boiler, passed through a small feed-water heater containing nine tubes, each 1 ft. long and 3 in. in diameter, filled with granular material to facilitate the exchange of heat.

This combination of boiler and feed-water heater proved remarkably successful in every way; its thermal efficiency was 94 per cent., with an evaporation of from 21 to 33 lb. per sq. ft. of heating surface per hour.

The 110-Tube Boiler at the Skinningrove Ironworks.

Six months' continuous experience with our first experimental unit gave us great confidence in its trustworthiness, so that when in the early months of 1911 we received an inquiry from the Skinningrove Iron Co., Ltd., for a boiler of about ten times the capacity of the experimental unit, to be fired by means of the surplus gas from their new Otto by-product coking-plant, we had no hesitation in accepting a commission to install our first large boiler there, under a strict guarantee as to its output and efficiency.

The plant was successfully started up on November 7, 1911, for a month's trial run—day and night continuously—after which it was opened up for an official inspection by the representative of a Boiler Insurance Company. Everything worked without a hitch during this trial; steam was generated at 100 lb. gauge pressure, from a feed-water of about 4° of hardness, whilst the average temperature of the waste gases leaving the feed-water heater was reduced to 80° C. (say 175° F.), a sure indication of the high thermal efficiency of the plant. When, at the conclusion of the month's trial, the boiler was opened up for inspection, the combustion tubes were found to be in good condition and free from scale; indeed, owing to the extremely high rate of evaporation, the scaling troubles experienced with other types of multitubular boilers appear to be completely obviated, the scale being automatically and continuously shed from the tube in thin films (about 1/30 in. thick) as fast as it is formed; a very important advantage, as anyone who is plagued by scaling troubles will appreciate. An independent trial of the plant on July 29, 1912, gave a thermal efficiency of 92.7 per cent.

Within the last few months the firm of Krupps have put down a boiler in connection with one of their coking plants in the Ruhr district of Westphalia, from the plans of the Skinningrove plant. This boiler has been running successfully since October last, and about three weeks ago underwent its official steam trials, which were carried out by the Bergbauliche Verein. Pending the official publication of the results in the German technical Press, I am precluded from giving any details now, but, I am informed, that they have entirely confirmed the Skinningrove trial.

I have perhaps said enough already about the boiler and its working to convince you that it combines high thermal efficiency and concentration of power, in a unique degree, and perhaps I may be permitted to summarise the other important advantages which may be claimed for it. First, from the constructional point of view, nothing could be simpler or more compact than a cylindrical shell only 4 ft. long by 10 ft. in diameter, traversed by straight tubes, supported on a casting, and requiring neither elaborate brickwork setting nor expensive chimney flues and stack. Secondly, it has a further advantage over all multitubular boilers in that the front plate can never be heated beyond the temperature of the water, however much the firing may be forced, a circumstance which, coupled with the extremely short length of the tubes, implies an absence of strain and greatly reduces the risk of leaky joints. Thirdly, the high rate of mean evaporation obviates scaling troubles, and the very steep evaporation gradient along each tube causes a considerable natural circulation of water in the boiler, a factor of great importance from the point of view of good and efficient working; in this connection I may remind you that under normal working conditions we obtain a *mean evaporation* of 20 lb. per sq ft. of heating surface an hour, and can, if need be, force this up to 35 lb.; of this total evaporation, 70 per cent. occurs over the first *third* length of the tube, 22 per cent over the *second* third, and only 8 per cent. over the last third. Fourthly, inasmuch as each tube of the boiler is, so to speak, an independent combustion unit, capable of being shut off or lit up without affecting the others, and as it only takes five minutes after lighting up a cold tube to attain its maximum steam output, it is obvious that not only is such a boiler highly responsive to rapid variations in the load, but also it works with equal efficiency at both small and big loads; indeed, within very wide limits, its efficiency is practically independent of the load.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Aberdeen.—Lord Elgin has been elected Chancellor of the University in succession to Lord Strathcona.

London.—The following courses of advanced lectures, addressed to students of the University and to others interested in the respective subjects, to which admission is free without ticket, are announced in the issue of the *London University Gazette* of April 8:—Five lectures on the earlier Palæozoic land plants at University College, by Dr. D. H. Scott, on Wednesdays, May 6 to June 3; two lectures on plant pigments at University College, by Prof. R. Willstätter, professor of chemistry in the University of Berlin, on Monday, May 4, and Tuesday, May 5; two lectures, in French, entitled "La Catalyse, et mes divers travaux sur la Catalyse," at King's College, by Prof. Paul Sabatier, of the University of Toulouse, on Thursday, May 14, and Friday, May 15; eight lectures on the rate of the blood-flow in man in health and disease, in the Physiological Laboratory of the University, South Kensington, by Prof. G. N. Stewart, professor of experimental medicine, Western Reserve University, Cleveland, U.S.A., on Tuesdays, May 5–23; eight lectures on oxidation in the tissues, at University College, by Dr. C. Lovatt Evans, on Fridays, May 8 to June 26; four lectures on the regulation of the composition and volume of the blood, in the Physiological Laboratory of Guy's Hospital, by Dr. J. S. Haldane, on Thursdays, May 7–28; four lectures on the gaseous exchanges of the body, in the Physiological Laboratory of King's College, by Prof. T. G. Brodie, professor of physiology in the University of Toronto, on Monday, June 8, Wednesday, June 10, Monday, June 15, and Wednesday, June 17; three lectures on the morphology of the cranial muscles in vertebrates, in the Zoological Department, University College, by Prof. F. H. Edgeworth, professor of medicine in the University of Bristol, on Monday, May 4, Tuesday, May 5, and Wednesday, May 6; five lectures on the measurement of social phenomena, at the London School of Economics and Political Science, by Dr. A. L. Bowley, University reader in statistics, on Mondays, April 27 to May 25.

Among the public lectures, to which admission is free without ticket, announced to be delivered at University College during the third term of the present academic year, the following may be mentioned:—Four lectures on the ethnology and pathology of the ancient Egyptians, by Dr. D. E. Derry, beginning on May 5, at 5 p.m.; a lecture on Ptolemy's map of Germany and the Cimbric Chersonese, by Prof. Gudmudd Schütte, on May 11, at 5 p.m.; an introductory lecture on recent discoveries in Egypt, by Prof. Flinders Petrie, on May 21, at 2.30 p.m.

Glasgow.—The following doctorates were among the degrees conferred on April 20:—Doctor of Philosophy (D.Phil.): L. J. Russell; thesis, "The Development of the Philosophy of Leibniz, 1666–86." Doctors of Science (D.Sc.): Margaret B. Moir; thesis, "The Influence of Temperature on the Magnetic Properties of Carbon Steels; Sensitive Magnetic State induced by Thermal Treatment and by Strain; Magnetic Properties of Chrome Steels at Ordinary and Low Temperatures: Permanent Magnetism of Chrome Steels; with other papers." F. Mort; thesis, "North Arran: a Physiographic Study; with others papers." Maggie M. J. Sutherland; thesis, "Camphenanic Acid, its Isomers and Derivatives; with other papers."

Science states that a contribution of 10,000*l*. from Mrs. E. H. Harriman to the endowment fund of Barnard College, Columbia University, is announced toward the million dollar fund now being raised for the twenty-fifth anniversary of the institution. The amount now promised is 110,000*l*.

Mr. H. Norman Edge has been appointed honorary lecturer on meteorology to the Lancashire (Navy League) and National Sea Training Homes. As increased attention is now being given to the subject of marine meteorology, and a number of vessels keep a four-hourly log, the instruction in the keeping of the meteorological log to boys being prepared for a seafaring life is of real practical value.

It is announced in the *Times* that the late Mr. H. B. Noble, of Douglas, Isle of Man, left practically all his large estate for educational and charitable purposes in the island. The trustees of his will have decided to devote 20,000*l*. for the fostering of agriculture in the island. In connection with this gift a Bill has been introduced into the Manx Legislature constituting a Board of Agriculture for the island. The Board will administer the income arising from the gift, and will, in addition, have a fund placed at its disposal by the Government of the island.

A comprehensive resolution dealing with the age of exemption from attendance at school, continuation classes, and child labour, was passed by the National Union of Teachers at the Lowestoft conference on April 15. The resolution, which was moved by Mr. G. Sharples, was as follows:—That all regulations recognising the half-time system, labour examinations, and other forms of early exemption from attendance at school should be abolished; that no child should be exempt from attending under the age of fourteen; that local authorities should be empowered to make by-laws requiring the attendance of children up to the age of fifteen; that all wage-earning work, and particularly all street trading, should be prohibited for all children under fourteen, both in urban and rural districts; and that a system of compulsory attendance at continuation classes should be established for children between the ages of fourteen and eighteen who are not otherwise receiving a suitable education, such a system to be accompanied by a statutory limitation of the hours of child labour.

A weak point in most of the Continental educational systems is that there is no easy bridge by which the public elementary and trade continuation class pupil can pass into the higher ranks of his vocation and complete his studies in the polytechnic or university. The avenue to these higher institutions is almost solely through the gymnasial secondary schools. In the facilities offered by scholarships for the transference of gifted pupils from primary schools to secondary schools and through these to universities and like places of advanced learning, we have nothing to learn from Continental methods. The scholarship systems of the education authorities of English counties and county boroughs provide the means by which any elementary-school pupil of little more than average ability can obtain a free-place in a secondary school; and the brilliant pupil can proceed from this stage to a higher by means of senior scholarships. We are reminded of the efficiency of this educational ladder by a return just made to the Somerset County Council by the County Education Committee. It appears from this report that twenty-five out of the thirty senior county scholars referred to in it were enabled by the Education Committee's system of scholarships to pass from a public elementary school to a university or a university college. Many of the senior scholars have had remarkably successful careers since their university courses, and some have reached exceptional distinction. The return as a whole is very gratifying, and the result is due in part at least to the committee's policy of awarding scholarships of any grade only when candidates of really satisfactory merit present themselves.

Mr. J. A. Pease, Minister of Education, last week received at the offices of the Board in Whitehall, an influential deputation representing the civic, commercial, and educational life of Nottingham, and headed by the Duke of Portland, on the subject of granting the status of a university to University College, Nottingham. His Grace gave a *résumé* of the history of the college, emphasising the fact that its work would bear favourable comparison with that of the majority of the modern universities in the country. The time had now come when steps should be taken to broaden the constitution of the college, to place it in the same position as other similar institutions, and to establish it definitely as the university centre of the east midlands, spreading the responsibility for its government and maintenance over the area which it serves. Principal Heaton dwelt upon the educational work in the college itself, especially its honours, post-graduate, and research work, upon the home the college afforded to local branches of various national associations (such as Classical, Historical, English, Workers' Educational, Chemical Industry), and on the increased facilities it now offered for social intercourse among the students. The patriotic side of its work was well represented by its efficient Officers Training Corps, and the fact that it was the first college in England to form for women students a voluntary-aid detachment of the Red Cross Association. In his reply, Mr. Pease said :—"I appreciate, and the Board of Education appreciates, the desires of the people of Nottingham, their ambition, their aspiration, in connection with the formation of what one might call a full-blown university. There are schools of thought which think provincial universities have already been established in enough centres up and down our land. I am not one of those who take this view; I believe that there is work for additional universities, and I for one would be very glad to see a provincial university which would meet all requirements in connection with the wants of the people in the east midland area."

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, March 16.—Prof. James Geikie, president, in the chair.—Rev. T. R. R. **Stebbing** : Stalk-eyed Crustacea Malacostraca of the Scottish National Antarctic Expedition. Most of the fifty specimens described were collected by the *Scotia* at various stations during its voyage out and home, so that not more than ten could claim to be Antarctic or sub-Antarctic in their place of capture. Six new species were described, viz., *Coryrhynchus algicola*, *Eupagurus modicellus*, *Gennadas kempi*, *Nauticarus brucei*, *Phye scotiae*, *P. rathbunae*.—D. W. **Steuart** and Ingvar **Jörgensen** : Note on the atmospheric electrical potential gradient in industrial districts. The experiments were carried out in the neighbourhood of Leeds. The chief feature was the magnitude of the potential gradient under certain conditions.—J. B. **Robertson** : A chemical examination of the organic matter in oil-shales. Thirteen samples had been analysed. The carbon hydrogen ratio varied from 6 to 8, the lower ratio belonging to the shale yielding the larger amount of oil produced from a definite percentage of organic matter. The ratios were lower than that of ordinary bituminous coal. The organic matter, the main bulk of which was insoluble in organic solvents, was the product of the decomposition of vegetable substance (algæ, spores, etc.), similar in nature to what was found in peat and cannel coal.

Paris.

Academy of Sciences, April 14.—M. P. Appell in the chair.—L. E. **Bertin** : Calculation of the increase of load or of velocity obtainable by increasing the dimensions of ships. A development of some consequences of a formula given in an earlier communication.—G. **Gouy** : The absorbing power of the electric arc for its own radiations. Confirming results previously obtained with flame spectra, a complete opacity of the vapour for the line it produces is never observed. The absorptive power is between 0·5 and 0·7 for the very strong lines, and less for the weaker lines.—A. **Laveran** : New facts tending to demonstrate that Mediterranean kala-azar is identical with the Indian kala-azar. Comparative inoculation experiments were carried out on monkeys, dogs, and mice. *Macacus cynomolgus* rendered immune to the Mediterranean kala-azar is refractory to the Indian virus, whilst another animal of the same species, inoculated under the same conditions as the first, and serving as a control, rapidly contracted a fatal infection. From this it is concluded that the diseases are identical.—A. **Bilimovitch** : The canonical transformations of the equations of motion of a non-holonomial system.—L. **Dunoyer** and R. W. **Wood** : Photometry of the superficial resonance of sodium vapour under the stimulation of the D lines. Fineness of the resonance lines. The magnitude of the resonance lines was of the order of 0·03 Ångström.—Félix **Ehrenhaft** : Minimum quantities of electricity and the existence of quantities (quanta) smaller than the charge of an electron. The electrical charges of particles of mercury and gold in the colloidal state were determined, the spherical shape of the particles under examination being previously proved by the microscope. The minimum charge is not the charge of the electron.—Albert **Perrier** and H Kamerlingh **Onnes** : The interpretation of the magnetic properties of mixtures of oxygen and nitrogen. The molecular field varies inversely as the third power of the mean distance of the oxygen molecules.—R. **Fosse** : The gravimetric quantitative analysis of urea. The urea is precipitated from an acetic acid solution with xanthydrol, and the compound weighed. Its composition is definite, and can be controlled by analysis.—J. **Bergonié** : The rational distribution of meals in man in the nycthemeral cycle. The best times are shown to be 7.30 a.m. for principal meal, 4.30 p.m., and 8 p.m.

BOOKS RECEIVED.

Echinoderma of the Indian Museum. Part viii. Echinoidea (1). By Prof. R. Koehler. Pp. 258+xx plates. (Calcutta: Indian Museum.) 20 rupees.

Gibt es denkende Tiere? By Dr. S. v. Máday. Pp. xiv+461. (Leipzig and Berlin: W. Engelmann). 9.60 marks.

Die wichtigsten Lagerstätten der "Nicht-Erze." By Dr. O. Stutzer. Zweiter Teil. Kohle (Allgemeine

Kohlengeologie). Pp. xvi+345+xxix plates. (Berlin: Gebrüder Borntraeger.) 16 marks.

Ministry of Public Works, Egypt. Zoological Service. Report on a Zoological Mission to India in 1913. By Capt. S. S. Flower. Pp. viii+100+xii plates. (Cairo: Government Press.) 5*s*.

Mysore Geological Department. Report of the Chief Inspector of Mines for the Year 1912–13. With Statistics for the Calendar Year 1912. Pp. 59+tables. (Bangalore: Government Press.) 2 rupees.

Nedboriagttagelser i Norge. Utgit av det Norske Meteorologiske Institut, Middelværdier, Maksima og Minima. Pp. xxii+79+79+iv plates+maps. (Kristiania: H. Aschehoug and Co.) 3 kroners.

The Foundations of Character. By A. F. Shand. Pp. xxxi+532. (London: Macmillan and Co., Ltd.) 12*s*. net.

Marriage Ceremonies in Morocco. By Prof. E. Westermarck. Pp. xxi+422. (London: Macmillan and Co., Ltd.) 12*s*. net.

Icones of the Plants of Formosa, and Materials for a Flora of the Island. By B. Hayata. Vol. iii. Pp. iv+222+xxxv plates. (Taihoku: Bureau of Productive Industries.)

La Cémentation de l'Acier. By Prof. F. Giolitti. French translation by M. A. Portevin. Pp. 548. (Paris: A. Hermann et Fils.) 16 francs.

Traité de Physique. By Prof. O. D. Chwolson. Translated by E. Davaux. Tome Cinquième. Premier Fascicule. Champ magnétique variable. Pp. vi+266. (Paris: A. Hermann et Fils.) 9 francs.

Publications de la Société de Chimie-Physique. vii., Le Paramagnétisme appliqué a l'Etude des sels Métalliques. By Mlle. E. Feytis. Pp. 27. viii., Relations entre la constitution Chimique et la Coloration des Corps Organiques. By M. A. Meyer. Pp. 48. (Paris: A. Hermann et Fils.) 1 franc and 2 francs respectively.

Encyclopédie de Science Chimique Appliquée. Tome v. Principes d'Analyse et de Synthèse en Chimie Organique. By M. Hanriot, Prof. P. Carré, A Seyewetz, Prof. E. Charabot, and Dr. A. Hébert. Pp. 795. (Paris and Liége: Ch. Béranger.) 30 francs.

DIARY OF SOCIETIES.

THURSDAY, April 23.

Royal Geographical Society, at 5.—The East African Trough: J. Parkinson.

Child Study Society, at 7.30.—Raising the Standard of Child Upbringing Rev. I C. Pringle.

Concrete Institute, at 7.30.—The Architect and Structural Engineering: W. E A. Brown.

Institution of Electrical Engineers, at 8.—Electrification of Railways as affected by Traffic Considerations: H. W. Firth.

Royal Society of Arts, at 4.30.—The Port and City of Rangoon: G. C. Buchanan.

FRIDAY, April 24.

Royal Institution, at 9.—The Stars around the North Pole: Dr. F. W. Dyson.

Junior Institution of Engineers, at 8.—A Visit to the Iron Districts of French Alsace: G. Evetts

Institution of Mechanical Engineers, at 8.—Application of Electrical Driving to Existing Rolling Mills: L. Rothera.

SATURDAY, April 25.

Royal Institution, at 3.—Similarity of Motion in Fluids. I. The Theory of Similarity of Motion in Fluids and the Experimental Proof of its Existence: Dr. T. E. Stanton.

MONDAY, April 27.

Royal Society of Arts, at 8.—Some Recent Developments in the Ceramic Industry: W. Burton.

Royal Geographical Society, at 8.30.—The Land of the Ibibios (Southern Nigeria): P. A. Talbot.

Institute of Actuaries, at 5.—Section 72 of the National Insurance Act. Some other Features of Friendly Societies and National Insurance, including a Note on the Proposed Belgian National Insurance Act: E. B. Nathan.

TUESDAY, April 28.

Royal Institution, at 3.—Problems of Physical Chemistry. 2. Structure of Matter at low Temperatures: Dr. W. Wahl.

Royal Society of Arts, at 4 30—The Administration of Imperial Telegraphs: C. Bright.

Royal Anthropological Institute, at 8.15.—Some Hopi Textiles from the Pueblo of Hano: Miss B. Freire Marreco.

Eugenics Education Society, at 8.30.—Le Mesure de l'Intelligence: Dr. Simon.

WEDNESDAY, April 29.

Royal Society of Arts, at 8.—The Need for a Better Organization of Economic and Industrial Resources: C. R. Enock.

Geological Society, at 8.—On the Lower Jaw of an Anthropoid Ape (Dryopithecus) from the Upper Miocene of Lérida (Spain): Dr. A. Smith Woodward.—The Structure of ihe Carlisle—Solway Basin and the Sequence of its Permian and Triassic Rocks: Prof. J. W. Gregory.

THURSDAY, April 30.

Royal Society, at 4.30.—*Probable Papers*: The lack of Adaptation in the Tristichaceae and Podostemaceae: Dr. J. C. Willis.—The Genetics of Tetraploid Plants in *Primula sinensis*: R. P. Gregory.—The Action of certain Drugs on the isolated Human Uterus: J. A. Gunn.—The Presence of Inorganic Iron Compounds in the Chloroplasts of the Green Cells of Plants, considered in Relationship to Natural Photo-synthesis and the Origin of Life: Prof. B. Moore.—The Influence of Osmotic Pressure upon the Regeneration of *Gunda ulvae*: D. J. Lloyd.—(1) *Glossina brevipalpis* as a Carrier of Trypanosome Disease in Nyasaland. (2) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma pecorum*. Part III. Development in *Glossina morsitans*: Sir D. Bruce, Major A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.

Royal Institution, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic; The very Rev. W. R. Inge.

FRIDAY, May 1.

Royal Institution, at 9.—A Criticism on Critics: E. F. Benson.

Junior Institution of Engineers, at 8.—The Control and Organisation of the Engineering Profession: S. T. Robson.

Geologists' Association, at 8.—A Geological Excursion in Matabeleland: F. P. Mennell.

SATURDAY, May 2.

Royal Institution, at 3.—Similarity of Motion in Fluids. (2) The General Law of Surface Friction in Fluid Motion: Dr. T. E. Stanton.

British Psychological Society.—The Psychology of Play with special reference to the value of Group Games in Education: Miss M. J. Reaney. —Corresponding points: Prof. C. Spearman.—An attempt at an exact Estimation of Character: E. Webb.

CONTENTS.

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THURSDAY, APRIL 30, 1914.

NEW YORK WATER SUPPLY.

The Catskill Water Supply of New York City: History, Location, Sub-surface Investigations, and Construction. By Lazarus White. Pp. xxxii+755. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 25*s.* 6*d.* net.

TECHNICAL records of important engineering undertakings, so far as their accessibility to the public is concerned, are apt to be scattered and fragmentary. A paper will usually be read before one or other of the leading professional societies, giving in condensed form so much of the history of the work as is deemed suitable for publication. In addition, articles will have appeared from time to time in the technical and daily Press, authoritative in varying degree, giving descriptions in general terms of the progress made. But these, while admirable in themselves, scarcely exhaust the desire for information on the part of the general body of the profession, who would often wish to be furnished with certain specific details omitted from the condensed official accounts. A marked reticence, for instance, is observed, as a rule, on the subject of cost. There seems to be a fear lest the disclosure of more than a few figures of comprehensive significance should give rise to criticism of an adverse and inconvenient nature. And such details, accordingly, are almost invariably withheld, or, at best, are obtainable with difficulty.

These remarks are prompted by the consideration that the volume before us is quite exceptional in its scope and treatment to the experience described above. It is a commendably full, clear, and complete account of an undertaking of considerable magnitude, in which a great wealth of information germane to the subject is set out in much detail.

The author, a division engineer engaged on the work, has been fortunate in a chief who encouraged him in his task of compilation, and "gave him a helping hand throughout." He was also favoured with the cooperation of his colleagues. The long list of names mentioned in the preface demonstrates a very generous and loyal effort on the part of all concerned to produce a trustworthy and comprehensive account of the experience gained, the difficulties encountered and overcome, and the carrying through to a successful conclusion of a notable engineering feat.

The water supply of New York City has long been the subject of contention and conflicting opinion. It has been derived from many and varied sources. In the early days of Dutch colonisation it was mainly drawn from public and private wells. One well in particular, we are told, known as the Tea Water Pump, was so frequented that its neighbourhood became congested with water carts, and the spout of the pump had to be raised and lengthened to permit pedestrians to pass under it. Wells, however, are not a very trustworthy source of supply, and with the growth of the town they became tainted and inadequate. Spurred on by the ravages of epidemics which visited them, the inhabitants initiated a variety of schemes for obtaining a better and purer service; but it was not until 1830 that the first public waterworks were inaugurated. These consisted of a shaft, 16 ft. in diameter, sunk 112 ft. deep into the solid rock at a point situated at the junction of 13th Street and Broadway, with two horizontal galleries near the bottom of the shaft. The daily yield obtained by pumping was 21,000 gallons—an utterly inadequate provision for the needs of a rapidly-developing town.

The first really effective undertaking was the old Croton overflow weir or dam and aqueduct, constructed between 1837 and 1842, the former being located about six miles above the mouth of the Croton River. The capacity of the aqueduct was estimated at from 72 to 95 million gallons a day, and the population at this time was about 300,000. As time went on, it became necessary to increase the number and capacity of the storage reservoirs, and in spite of efforts made in that direction, the city experienced serious shortages of water in the years 1869, 1876, 1880, and 1881. By this last-named date, the population had increased to a million and a quarter, while the supply, augmented by a connection with the Bronx River, did not come to more than 102 million gallons a day. It was estimated that the demand was for 45 million gallons in excess of this. And here it may be remarked, in passing, that the daily consumption of water per head is curiously very much higher in the United States than it is in this country. For six of the largest cities in the United Kingdom, the quantity averages 35 gallons per head, as compared with more than 100 gallons in New York, 139 gallons in Chicago, and 187 gallons in Philadelphia.

The new Croton aqueduct from Croton Lake was built between 1885 and 1890, and the daily consumption of the population of 1,720,000 in 1890 immediately mounted to 170 million gallons —about one-half of the maximum capacity of the supply. The new Croton dam, commenced in 1892, was completed as recently as 1907.

As, owing to the growth of the city, the capacity of the Croton watershed showed signs of becoming exhausted at an early date, a commission was appointed, in 1903, to report on the whole question of future policy, and after due inquiry they recommended the impounding of the Catskill watershed, including the Esopus, Rondout, Schoharie, and Catskill creeks. Following this report, in 1905, the Board of Water Supply was organised, and the necessary sanction having been obtained, the field was open for operations to be commenced.

The basins from which the new supply is taken lie due north of New York, within a range of about one hundred miles from the centre of the city. It is calculated that the available yield of the total area is about 660 million gallons daily, but from this, for the present, at any rate, must be deducted the Schoharie watershed (136 million gallons), for which powers of incorporation have not been granted.

At this point we must leave the reader who wishes to pursue his researches further to do so in the volume itself. It will be found replete with data and particulars relating to the various contracts entered into for the execution of the project which has just recently been completed, and the author must be complimented on the result of his painstaking efforts to produce an account worthy of the achievement, which, with its 120 miles of dams, aqueducts, and tunnels, he proudly describes as "hardly second to the Panama Canal."

B. C.

ROMANCE IN ARCHÆOLOGY.

Egyptian Art. Studies by Sir Gaston Maspero. Translated by Elizabeth Lee. Pp. 223+plates. (London and Leipzig: T. Fisher Unwin, 1913.) Price 21*s*. net.

"AT two o'clock in the afternoon of February 12, 1906, while Naville was finishing his lunch, a workman came running up to tell him that the top of a vault was beginning to emerge from the earth." This is the opening sentence of the eleventh section or chapter in Sir Gaston Maspero's latest work, and it may serve as an indication of the book's quality. We here have no carefully reasoned presentation of the various aspects and problems presented by Egyptian Art. Such a work, by the same author, we already possess in "Art in Egypt," which has appeared within the year in the *Ars una: species mille* Series. "Egyptian Art" falls into quite a different category, and will prove an admirable foil or supplement to the more formal treatise.

It consists, in fact, as a sub-title warns us, of a collection of "Studies," written during a period of more than thirty years, which have been rescued from the pages of old periodicals, and are here presented together in an attractive English dress. Each is a separate essay, complete in itself; in some a single piece of Egyptian sculpture is described; others deal with an allied group of pieces, or of goldsmiths' work. But one characteristic is common to them all: the subject is used as a peg on which the author displays some idea or principle, generally of wider application than the particular example he selects. So any reader who already possesses "Art in Egypt" will here find Sir Gaston's views applied in a number of specific instances. The relation of the two books is very much that of a treatise on algebra to a series of worked-out problems.

The papers are here translated direct from the journals in which they made their first appearance, and have been subjected to no subsequent re-writing. Consequently, describing, as several of them do, masterpieces of Egyptian art within a day or two of their discovery, they still reflect the author's first enthusiasm, unblunted by later familiarity. The reader is transported from the atmosphere of a museum to the clear air of the Egyptian desert. He watches the diggers at their work, and shares something of their excitement. If he continues the chapter from which we quoted the opening words, he will soon see the head of the wonderful Hathor Cow standing out from the black recesses of the rock-hewn vault at Deir-el-Bahari as the *débris* of centuries is removed. Or turning to chapter xvii. he may, if he will, stand with Sir Gaston's *ghafirs* as they watch the workmen who are making a railway embankment on the site of ancient Bubastis. It has been reported that jewelry has been found; the police have searched the workmen's houses, and have recovered some of the pieces, but the fellahs have kept their secret. Suddenly a workman with his pick lays bare several fragments of silver. He tries to conceal them, but the *ghafirs* are too quick for him; and soon the Treasure of Zagazig, exquisite jewelry and vases of the XIXth Dynasty, is uncovered in the sunlight, a heap of gold between two layers of silver.

We have purposely laid stress on the vivid character of Sir Gaston's pages, for they serve to restore the element of romance which of late years archæology has run some risk of losing, at least for the general reader. But in doing so, we have left no space to touch on the general principles which the essays are intended to drive home, such as the utilitarian character of Egyptian art and the influence of a fixed purpose on its forms and conventions. Nor can we follow the author in his discrimination of the local schools of sculpture, each with its own traditions and technique. It may suffice to say that in "Art in Egypt" the reader will find these subjects treated systematically. In the work before us he will see Sir Gaston Maspero evolving the principles he there explains. A special word of praise must be given to the illustrations, the great majority of which are admirable reproductions of photographs on a large scale. L. W. K.

ASTRONOMY.

Astronomy: a Popular Handbook. By Prof. Harold Jacoby. Pp. xiii+435+32 plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

IN the arrangement of the subject-matter in this book the author has attempted to serve a double purpose, namely, to provide material to satisfy the requirements of the ordinary reader who wishes to make himself acquainted with the present state of astronomy and also to produce a text-book for use in high schools and colleges. To attain this end the book consists of two parts, the former being a series of chatty discourses on astronomical matters devoid of all mathematics, the latter, called an appendix, which contains a series of notes involving the occasional use of elementary algebra, geometry and trigonometry so far as the solution of plane right angle triangles. The first part covers 361 pages and the second 58 pages.

As an introduction the author gives the reader a good general idea of the whole universe, at the same time pointing out the practical use of astronomy and its value as a culture study. In the subsequent twenty chapters he deals with the subject more in detail. The general reader will find that the author has been very clear and precise in all his statements and presents the matter in an easy, readable form. The thirty-two plates and numerous figures in the text enhance the value of the book considerably, the reproductions being principally from the fine negatives secured by Barnard and by the astronomers at the Lick Observatory.

In reading the book a few points have come to the reviewer's notice which rather invite criticism. In the chapter on solar parallax a good account is given of Gill's determinations, but while reference is made to the Eros value, the name of Mr. Hinks is omitted. In describing the solar features the reader is shown a fine photograph of the solar disc taken in calcium light by Fox; while the bright portions shown in the reproduction are referred to as faculæ, the usual term "flocculi" is not mentioned.

Of recent years fine photographs of the spectra of comets have been secured, but the reference to a comet's spectrum here given is decidedly brief, and occupies two lines as follows: ". . . existence of hydrocarbon gas in a luminous state as well as a dim continuous spectrum containing Frauenhofer lines. . ." Stellar spectra classification is also curtly dismissed, being restricted to that given by Secchi, the fact that other classifications have been suggested and are in use receiving no mention whatever.

It may be said, however, that in spite of the above minor deficiencies, the book is one that will serve a very useful purpose, and should appeal to a large circle of readers.

TEXTILE FIBRES.

(1) *Chemische Technologie der Gespinstfasern.* By Dr. Karl Stirm. Pp. xvi+410. (Berlin: Gebrüder Borntraeger, 1913.) Price 12 marks.

(2) *The Textile Fibres: their Physical, Microscopical, and Chemical Properties.* By Dr. J. Merritt Matthews. Third edition. Pp. xi+630. (New York: John Wiley and Sons; London: Chapman and Hall, 1913.) Price 17*s.* net.

(1) IT cannot be said that the contents of this work quite correspond to its title, for if the chemical parts of the subject were left out altogether, a very substantial volume would still remain. The actual chemical technology of the fibres is inadequately represented, though the author may be said to err rather on the side of omissions than on that of mis-statements. In this latter respect, however, attention should be directed to the statement (p. 6) that the temperature at which cotton begins to decompose is 160° C., no mention being made of the time factor used in arriving at this result. It is well known that by prolonged heating cellulose begins to decompose at much lower temperatures than that stated. A further statement that caustic potash is much less energetic in its action on cellulose than caustic soda might well have been qualified, for in equivalent strengths there is no difference in the mercerising action of the two alkalies. Again, the descriptions of the processes of bleaching cotton and linen are of the nature of generalisations, and are more likely to confuse than to enlighten the student. It might have been expected that the work of Haller, Lester, Knecht and Allan, Hoff-

meister, and others on the natural impurities contained in these fibres would at least have been mentioned, but such is not the case. On p. 37 reference is made to the presence in raw cotton of resins which withstand the action of alkalies, but no mention is made of the source of the information nor does the author appear to have published any original communication on this subject.

Wool and silk are more adequately dealt with from the chemical point of view, though here we miss a very important property of the former, viz., its behaviour on steaming which Breinl has shown to account for "ending" in the dyeing of piece goods (by which is meant that one end of the piece comes out deeper in shade than the other). A fairly good account is also given of the artificial fibres.

The rest of the work (pp. 261–378) contains what can scarcely be called more than a rudimentary account of dyeing and printing, in which the chemistry of the products employed and of the processes plays a very subordinate part.

The figures in the work are generally good, but it appears strange that in a special work of this kind the author has not recognised the importance of giving the appearance of cross-sections of the fibres described. A very large proportion of the text is taken up by matter which is quite irrelevant to the subject. Thus, in the case of wool no fewer than five pages are taken up by a description of the spinning process, while five more are devoted to trade statistics. Altogether the work is disappointing. It must, however, be said in its favour that the author generally acknowledges the source of his information, which has been largely taken from other German works. His copious references to current literature will act as a good guide to students and others who make use of the book.

(2) Since the textile fibres constitute the raw materials for some of our most important industries, a well-planned and conscientiously compiled monograph on the subject, in which all the facts concerning them are systematised and lucidly discussed, should form a welcome addition to our technical literature. It has been the endeavour of the author, in writing the present volume, to carry out this ideal, and though he does not claim to have attained it, we have no hesitation in saying that he has produced a most useful monograph. The subject-matter is well arranged, and is brought up to date, chiefly in the copious footnotes which give epitomes of the more recent researches and patent specifications. The figures representing the textile fibres are mostly micrographs by the author, and although they are somewhat rough, they bring out the essential features more prominently than many of the photographic reproductions that have been published. The figure on p. 230 seems to be out of place.

The last, and not the least, useful part of the work (pp. 461–592) gives an account of the various methods available for the analysis of textile materials. In his classification of the fibres (especially bast fibres) and the enumeration of the numerous species of the genus Gossypium (cotton), the author is rather too profuse. No mention appears to be made of the important effect of drying mercerised cotton in decreasing its affinity for dyestuffs. While admitting in the footnote on p. 283 that cotton begins to decompose above 120° C., the author seems to place the temperature at which decomposition begins at 160° C. (p. 282), but both are too high. No mention is made of that excellent reagent paranitroaniline for lignocellulose. The chlorination of wool, which is now a most important large-scale operation in connection with the production of unshrinkable fabrics, might with advantage have been more fully gone into. In spite of these shortcomings, the work must be regarded as one of considerable merit. That it has supplied a want is shown by the fact that within a comparatively short period it has gone through two editions.

OUR BOOKSHELF.

Pflanzenphysiologie. Versuche und Beobachtungen an höheren und niederen Pflanzen einschliesslich Bakteriologie und Hydrobiologie mit Planktonkunde. By R. Kolkwitz. Pp. v + 258 + xii plates. (Jena: Gustav Fischer, 1914.) Price 9 marks.

Prof. Kolkwitz tells us that his book has grown out of courses of practical instruction in plant physiology for university and agricultural classes. It is a little difficult to see exactly for whom it is designed—students would probably find it a difficult book to use, still the teacher of ordinary plant physiology will discover many hints that he can utilise with advantage.

A number of experiments are described, illustrative of the physiology of the higher plants, but the greater part of the volume is devoted to the lower forms of life. This later portion is an odd mixture of systematic description of illustrative species, but the accounts given are often so meagre as to be practically worthless. Directions are given for the culture of some forms, and the distribution of certain plankton species is briefly discussed. Incidentally, the chief sources of information are usefully given, but the whole volume suggests that it is a reproduction of the private notes of a teacher who has explored a fairly wide field himself, and wants the notes to refresh his recollection while conducting a course for students. But it is perhaps not often that short notes of this kind are of very much service to anyone except the man who put them together.

Lessons in Elementary Tropical Hygiene. By Henry Strachan. Pp. xi+116+vi plates. (London: Constable and Co., Ltd., 1913.) Price 1*s.* net.

We heartily recommend this little book. It is, of course, quite simple and very elementary; that is what it was intended for. Still, London school-teachers will find many useful hints in it. But it is written chiefly for the help of school-teachers in the tropics, both in Africa and in the West Indies. The author has been Principal Medical Officer of Lagos and of Southern Nigeria, and for two years he was acting as Colonial Secretary in Lagos. If he does not know the feel of the white man's burden, who does? And he knows well that the way to put things right in this world is to get at the children. It is they who will hold the ground which our men of science have won in the tropics. The victories of protective medicine and of sanitary administration over tropical diseases in Africa are, to us older people, still new, still wonderful; to the children, before many years are past, they will be old stories retold, facts taken for granted.

Anaesthetics: their Uses and Administration. By Dr. D. W. Buxton. Fifth edition. Pp. xiv+477. (London: H. K. Lewis, 1914.) Price 10*s.* 6*d.* net.

The advances in the knowledge of anæsthesia and analgesia made it necessary for Dr. Buxton to rewrite most of the sections in the previous edition of his useful work, to delete obsolete apparatus and theories, and to add much new matter. Among other new features are the procedures involved in giving nitrous oxide and oxygen in major surgery; of ether by the open method, by intra-vascular infusion, by intra-tracheal and pharyngeal insufflation, and by colonic absorption; the methods of local regional and spinal analgesia, and the employment of alkaloids in analgesia and anæsthesia.

Defensive Ferments of the Animal Organism. By Emil Abderhalden. Third enlarged edition. English translation by Dr. J. O. Gavronsky and W. F. Lanchester. Pp. xx+242. (London: John Bale, Sons and Danielsson, Ltd., 1914.) Price 7*s.* 6*d.* net.

The first German edition of this work by the director of the Physiological Institute of the University at Halle a/S. was reviewed in the issue of Nature for September 19, 1912 (vol. xc., p. 66). That two further editions were published in Germany in the following year is good evidence of the increasing interest being shown in Abderhalden's methods. The English edition will serve to bring these researches within the range of English students to whom the German text has been inaccessible.

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.*]

Cellular Structure of Emulsions.

On Prof. Kerr Grant's letter (p. 162) see for previous observations of this striking phenomenon Prof. James Thomson, Proc. Glasgow Phil. Soc., February 15, 1882, reprinted in his collected Papers (p. 136); also by reference given in a footnote to the reprint, to more detailed and independent investigations by Prof. Bénard, of Bordeaux, in *Annales de Chimie,* 1901, and more recent papers, including a recent lecture to the Société de Physique, and to their discussion in connection with the solar phenomena referred to by Prof. Grant, by H. Deslandres, in the Annals of the Observatory of Meudon (vol. iv., 1910).

Joseph Larmor.

The cellular arrangement of convection currents in emulsions, described by Prof. Kerr Grant in Nature of April 16, was first recorded by E. H. Weber in 1855, with gamboge suspended in a mixture of alcohol and water. It is discussed in O. Lehmann's "Molekularphysik." The structure is most conveniently seen in molten wax or spermaceti, and in this form was discovered by H. Bénard. Many papers by Bénard, Dauzère, and others have appeared on the subject in the *Comptes rendus* and *Journal de Physique* since 1901, and the possible bearing of the phenomenon on geological and astronomical problems has been discussed. A paper by James Thomson on cellular structure due to convection, originally published in 1882, is included in his collected works. In this case soapy water was the liquid used. An account of the phenomenon, with references, is given in the present writer's report to the Beilby Prize Committee, read at the March meeting of the Institute of Metals.

Cecil H. Desch.

Metallurgical Laboratory,
University of Glasgow.

The Origin of the Moon and the Earth's Contraction.

In my letter to Nature of February 26, I said that, with the earth's radius and gravity at their present values, and with the speed of rotation assumed to be one revolution in five hours, gravitation would exceed the centrifugal force until a distance from the surface was reached of more than double the earth's radius. Dr. Ball upon this writes that I "concluded" that when the moon was detached from the earth, "the earth's radius must have been about three times its present one." I did not mean to imply this.

The whole subject of the moon's origin is highly speculative, as Sir G. H. Darwin himself admitted. There are two causes that might be invoked to account for the separation of her mass from the earth, viz., centrifugal force, and the sun's tidal action. These require different speeds of rotation. In Pratt's "Figure of the Earth," 4th ed., art. 102, he shows that with a homogeneous earth the time of rotation which would render the centrifugal force equal to gravity would be one revolution in two hours and twenty-four minutes. I think that if the central parts were the more dense the speed would be rather greater. It seems impossible that a solid crust could have formed at this early period, when the spheroid could only just hold together. The eccentricity would then have been about 0·22.

The other possible cause of separation would be that the times of the tide produced by the sun's attraction coincided with the period of gravitational oscillation of the mass of the spheroid; that is, that the period of free oscillation would be the same as that of the forced oscillation due to the solar tide. After this had gone on for some while, the tidal protuberances would become so large that, in the opinion of Sir G. H. Darwin, one (or both) might break away. He considered that the rate of rotation in this case would have been about one revolution in five hours. And it was this rate that I assumed in my letter to NATURE. By the time the earth's rotation had been reduced so far as this, it does not seem impossible that a crust might have been formed.

If the material which now constitutes the moon was in any way detached from the earth, the matter so detached cannot have coalesced into a single sphere until Roche's limit was passed, which would be 2·44 of the earth's radii from its centre. During this initial stage of the moon's existence the nearest analogy seems to be found in Saturn's rings. But the difficulty remains why the matter detached should not have fallen back again.

As regards the formation of mountains by the contraction of the earth, I have discussed the question to the best of my ability in my "Physics of the Earth's Crust," and have come to the conclusion that the theory is untenable. O. FISHER.

Graveley, Huntingdon, April 4.

Movements on Water Surfaces.

I HAVE often wondered what is the real explanation of the following observation. If on a bath of soapy water a skin is allowed to collect on the surface, and then lumps of soapy lather be allowed to drop from one's hands on to it, the skin will crack in all directions, radiating from the point where the skin was first pierced, and this will continue for some time after the initial cause of the disturbance has ceased. The phenomenon is very striking, and can be repeated several times, after which the effect cannot be produced. Also if a cake of wet soap be placed on a wet level surface, the moisture is repelled from the cake, until the latter becomes surrounded by a dry patch. These seem to suggest repulsion of similarly electrified bodies. EDWARD A. MARTIN.

MR. MARTIN's second question is more easily answered than his first. The surface tension of clean water is about three times as great as that of water containing soap, so when the soap touches the wet surface the surrounding wet being no longer pulled towards the soap as strongly as it is pulled away, obeys the latter force as fast as it can.

I am inclined to think that his first observation may relate to a similar phenomenon, but of this I am not sure. With oleate of soda a very small quantity reduces the tension to the lower limit at once, and with this I do not think the experiment would succeed. I can only suppose, but I do not know it as a fact, that with the soap used first a scum is formed, and then when fresh lather breaks this at a point there is rather less surface tension at this point than there is in the surrounding surface. If so, the result observed would naturally follow. I should not, however, have expected to find this difference in the surface tensions. Or, possibly, the lather from the hand is warmer and for this reason has somewhat less surface tension. I have often shown in a striking way the diminution of surface tension with rise of temperature by holding the hand steadily against one side of the rainbow cup when the film upon it is already thin and highly coloured. Almost immediately a circulation is set up and a stream leaves the part warmed by the hand, and crossing the film diametrically, curls round on either side, producing a tree-like pattern in other colours. The film is very sensitive to temperature changes. C. V. BOYS.

66 Victoria Street, London, S.W., April 24.

X-Ray Spectra.

J. HERWEG (*Berichte der Deutschen Physikalischen Gesellschaft*, Heft 1, 1914) using a crystal of gypsum, obtains by means of the photographic method the result that the α and β lines of the tungsten X-ray spectrum coincide with the α and β lines of the platinum X-ray spectrum, the values of the glancing angles being $4^\circ\ 56'$ and $4^\circ\ 16'$ for the α and β lines respectively. But there is reason to suppose that the wave-length of X-rays characteristic of an element varies inversely as the square of the atomic weight of that element. If this is so, we can calculate from the experimental results for a platinum antikathode obtained by Herweg the glancing angles for the tungsten X-ray spectrum and we obtain :—

Tungsten Antikathode (Calculated).

Spectrum line	α	β	γ	δ	ϵ
Glancing angle	$5^\circ\ 34'$	$4^\circ\ 48'$	$4^\circ\ 43'$	$4^\circ\ 6'$	$3^\circ\ 51'$

We thus see that the calculated values of the β and δ lines are nearly the same as the experimental values found by Herweg for what he calls the α and β lines of the tungsten spectrum. G. E. M. JAUNCEY.

Physical Laboratory, University of Toronto, March 30.

An Optical Illusion.

I HAVE often noticed the phenomenon mentioned by Mr. J. W. Giltay in NATURE of April 23 (p. 189). In the position in which he was reading the sunlight passed through his eyelids and the coats of his eyes, and on account of having to pass through a layer of blood which acted as a red screen his retinas become flooded with red light. The red is not noticed where it is diluted with white, but the print appears red because red light is falling on the portions of the retina which receive the images of the printed letters. F. W. EDRIDGE-GREEN.

SOME LIFE-HISTORIES AND HABITS OF INSECTS.[1]

(1) IN his "Insect Biographies," Mr. J. J. Ward has written a pleasant and popular account of the life-history of several of our best-known insects. He has contrived to show how full of interest are the facts concerning the growth, development, and general mode of life of the subjects of his pen and camera, without overburdening his pages with technicalities, or, on the other hand, being guilty of inaccuracy or looseness of statement. The photographs with which the book is plentifully illustrated have been in almost every instance taken directly from living specimens in their natural attitudes and surroundings, and their execution must have involved the

[1] (1) "Insect Biographies with Pen and Camera." By John J. Ward. Pp. 206+plates. (London: Jarrold and Sons. 1913.) Price 6*s*. net.
(2) "Lebensgewohnheiten und Instinkte der Insekten bis zum Erwachen der sozialen Instinkte." Geschildert von O. M Reuter. Vom Verfasser revidierte Uebersetzung nach dem schwedischen Manuskript besorgt von A. u. M. Buch. Pp. xvi+448. (Berlin: R. Friedlander und Sohn, 1913.) Price 16 marks.

expenditure of much time and patience. They form an important feature of the work, and are in most cases excellent examples of their kind; some of them, however, are too much reduced in size for perfect clearness. One of the best illustrations shows the extraordinarily indented outline of the "Comma" butterfly (*Vanessa C-album*) in its attitude of rest with closed wings. The eggs and larvæ of the common lace-wing fly (Chrysopa), valuable for its destructive activity among the aphides, form the material of a series of figures some of which are here reproduced, while the life-history of another foe to the aphid pest, the wasp-like hover-fly or syrphid, is also well illustrated on Mr. Ward's photographic plates. One of the best chapters in the book is that devoted to the subject of the tree- and ground-wasps; the construction of the nests is clearly explained and well figured. Another interesting section is that which deals with the hornet-like clear-wing moth (*Aegeria crabroniformis*), remarkable in its larval stage for its powers of burrowing in the trunks and branches of various species of willow. Much stress is laid throughout the book on the protective value of the forms and colours adopted by many of the subjects of illustration, and the author has ingenious explanations to offer of the meaning of several curious instincts, such as the wholesale destruction of wasp larvæ by the workers towards the end of the season. Mr. Ward's bionomic conclusions are for the most part well grounded, but he seems in some passages somewhat too ready to admit without question the interpretation of instinct as inherited habit.

5. Larva of the lace-wing fly attacking an aphis. 6. Head of the larva. 7. Cocoons formed by the larvæ. 8. Lace-wing fly depositing eggs on a lilac leaf. 9. Another view of the lace-wing fly and eggs. 5 and 6 are enlarged, and 7, 8, 9, are actual size. From "Insect Biogaphies with Pen and Camera."

(2) The name and reputation of the late Dr. Odo Reuter were a sufficient ground for the anticipation that his work on the habits and instincts of insects would be a contribution to entomological science of high value. Such expectations are fully borne out by the work before us, which has been translated into German by A. and M. Buch from the original Swedish. The various heads of the subject are treated with great care and thoroughness, and the importance of the book as a work of reference is enhanced by the useful list of recent literature which concludes the volume. Among the topics dealt with are the various manifestations of activity and rest, including sleep and hibernation, the instincts concerned in feeding, in parasitism, commensalism, and mutualism. A chapter is devoted to the subject of migration; and the various methods of protection, active and passive, against unfavourable natural conditions, and the attacks of insectivorous foes, receive extended treatment. Instincts associated with metamorphosis, with pairing, with oviposition, and provision for the future needs of the offspring, are also fully discussed; and much space is given to the nesting and feeding habits of the solitary bees and wasps. The treatise concludes with a consideration of the transition from the solitary to the social habit in insects.

Dr. Reuter brought together for this work a great quantity of information gathered from the recorded observations of many naturalists in different countries. The treatment can scarcely be called exhaustive, and it is almost inevitable that some parts of so wide a subject should be dealt with in greater detail than others of equal importance. But the book is a useful storehouse of facts, selected with discretion, arranged with judgment, and pleasantly recounted.

F. A. D.

THE MINERAL INDUSTRY OF CANADA.[1]

THE Department of Mines of Canada is doing excellent work in distributing information concerning the mineral wealth of the Dominion by means of publications that appeal both to the trained expert and to the seeker after general information. A good example of the latter form may be found in a pamphlet of some seventy-seven pages entitled "Economic Minerals and Mining Industries of Canada," written by the "Staff of the Mines Branch," which gives in clear and convenient form a brief review of the occurrences and distribution of all the economic mineral products of the Dominion of Canada, together with indications of the legislative enactments that control the tenure of mineral property, the latter being especially important, seeing that each province has its own mining laws. This popular description, which, though brief, is clear and easily intelligible to anyone interested in mining matters, should prove of the utmost value to prospectors or others who may be going to Canada and are anxious to acquire some general knowledge of the more important economic minerals that are found in Canada, of the districts in which they chiefly occur, and the conditions under which their occurrence may be looked for with the greatest probability of success.

No better example of the opposite extreme, that is to say, of publications written essentially for the trained mining or metallurgical engineer, can be quoted than the monograph on the nickel industry of Sudbury by Dr. A. P. Coleman, a work of some 200 pages, in which a full account is given of these important mineral deposits. The general geology of the region is first described in much detail, then descriptions of the various minerals met with and of typical forms of the ore deposits themselves, all of these being very careful and apparently very accurate. Dr. Coleman discusses the mode of formation of the deposits, and seems inclined to adopt the magmatic segregation theory in its simplest and most definite form; he certainly mentions the researches of Dr. Campbell and others which have shown that there is very much to be said in favour of the aqueous origin of the ores, but Dr. Coleman apparently lays but little stress on these. He does not appear to have considered the possibility that these conflicting views might be reconciled on the hypothesis that the ores might have been formed by some form of hydrothermal process, in which separation from a cooling magma in the presence of water in some form or other under conditions of intense pressure may have produced the phenomena that characterise these ore deposits. Detailed descriptions of the various mines are given, together with some account of the method of mining and an outline of the smelting processes in use. The value of the monograph is enhanced by a comparison of the nickel occurrences at Sudbury with the remaining most important sources of nickel in the world.

The Annual Report on the Mineral Production of Canada is a volume that interests both the specialist and the seeker after general information, though it must be admitted that it appears to cater for the latter rather than for the former class of reader, there being throughout evidence of a desire to make the figures, especially the value of the mineral production of Canada, look as large as possible. No doubt the pernicious example of its neighbour, the United States, has much to do with this striving after inflated figures. The unfortunate result is that the figures given in the report are not the real value of the mineral production of the Dominion, as several items appear more than once. Thus in the report on the mineral production for 1911 the grand total of the value of the mineral production is given as 103,220,994 dollars; this is made up of metallic products, 46,105,423 dollars, non-metallic products (in which are included such items as arsenious oxide, chromite, manganese, ochres, pyrites!), 34,405,960 dollars, and structural materials and clay products, 22,709,611 dollars. Amongst the so-called non-metallic mineral products, by far the most important is coal, the value of which is given as 26,467,646 dollars, or about 77 per cent. of the whole; a very large proportion of this coal is, however, used in smelting the metals which are included in the first-named group and in burning the Portland cement, bricks, tiles, and other ceramic goods, and the lime included in the last-named group. As the value of all these products depends in part, often in quite considerable part, upon the fuel used in their production, the value of the coal appears twice over in the above grand total. Furthermore, very large quantities of coal and coke are imported into Canada, their value in 1911 exceeding 41,000,000 dollars, and it is certain that a very large proportion of this imported fuel is also used in manufacturing the metallic and other products above referred to, so that the value assigned to these includes in no small part the value of the imports of coal, etc. In spite of these facts, which show that the value of the mineral products of

[1] "The Nickel Industry: with Special Reference to the Sudbury Region, Ontario." By Dr. O. P. Coleman. (Ottawa: Government Printing Bureau, 1913.)
"Annual Report on the Mineral Production of Canada during the Calendar Year 1911." By John McLeish, Chief of the Division of Mineral Resources and Statistics. (Ottawa: Government Printing Bureau, 1913.)
"Economic Minerals and Mining Industries of Canada." By the Staff of the Mines Branch. (Ottawa: Government Printing Bureau, 1913.)
"A General Summary of the Mineral Production of Canada during the Calendar Year 1912." By John McLeish. (Ottawa: Government Printing Bureau, 1913.)
"The Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals in Canada during the Calendar Year 1912." By Cosmo T. Cartwright. (Ottawa: Government Printing Bureau, 1913.)
"Summary Report of the Mines Branch of the Department of Mines for the Calendar Year ending December 31, 1912." (Ottawa, 1913.)

Canada cannot be compared with the mineral statistics of other countries unless these causes of inflation are taken into account, it is obvious that the Canadian mining industry is flourishing, and forms an important item in the wealth-producing power of the Dominion.

Important as was the mineral production in 1911, it appears to have been quite eclipsed by that of 1912, for it may be taken for granted that the figures contained in the General Summary, just issued, are not likely to be greatly modified in the final report. This gives the grand total of the entire mineral output, made up as it was in 1911, as 135,048,296 dollars, equal to an increase of 30·8 per cent. There is no new feature of any importance, except perhaps that the gold production shows an increase of about 40 per cent., due to the Porcupine district of Ontario. The silver output has fallen off slightly in Cobalt, but all other metals show an increased production. By far the most important mineral product is still coal, and as its output has increased by 28 per cent., this alone would cause the year to compare favourably with its predecessor. All that can fairly be said is that the 1912 report shows clearly that the mineral production of Canada is steadily growing in importance.

It is to be regretted that the scheme of Canadian mineral statistics takes no account of the labour conditions of the industry, and that no information is given concerning the number of men engaged in the industry, the wages earned by them, and of the accidents, fatal or non-fatal, that have befallen them during the year. Statistics on these points ought to be forthcoming in order to enable students of the subject to form a clearer picture of the course of development of the mineral industry of the Dominion.

The Report upon the production of the various metals in Canada may be taken as a final report, whilst it at the same time goes into somewhat greater detail than is possible in the General Summary, and also devotes more especial attention to the economic side of the subject. It can only be said fully to confirm the impression given by the General Summary as to the flourishing condition of the Canadian mineral industry.

The Summary Report of the work performed by the Mines Branch of the Department of Mines forms most interesting reading, and indicates that the Mines Branch is carrying out a vast amount of research work for the benefit of the mineral industry of the Dominion. A report upon the metallurgy of cobalt and its alloys, and another upon recent progress in the electrical manufacture of iron and steel may be named as indicating the nature of the work being carried on; it is most satisfactory to find evidence of the existence of a Government Department equipped for conducting such researches upon modern scientific lines, and to have such proof that the Canadian Government is far-seeing enough to give such excellent assistance to an important industry. It may fairly be said that if Canadian mineral industries are flourishing, the result is due not only to the great resources of the Dominion, but to the enlightened policy of a Government which devotes its energies to turning these resources to the best possible account.

IMPROVEMENTS IN THE BINOCULAR MICROSCOPE.

Microscopists long ago appreciated the advantages that might accrue could *both* eyes be employed to view the object by means of a "binocular" microscope—the natural method of viewing objects with both eyes would be preserved and eye-strain lessened, and stereoscopic vision may be attained.

The viewing of an object with both eyes not only lessens eye-strain, but there is a summation of stimuli in binocular vision, and, even without a stereoscopic effect, a better appreciation of the object viewed is probably obtained—there is greater "vividity" about the image.

Three principles have now been applied in the construction of the binocular microscope. The first of these is the use of two complete microscopes pointed obliquely at the same object, as in the Greenough binocular. This form has but a limited application as it is adapted for low-power work only. In the second form, best represented by the "Wenham" binocular and its modifications, the light coming from a single objective

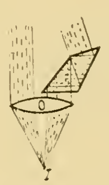

Fig. 1.

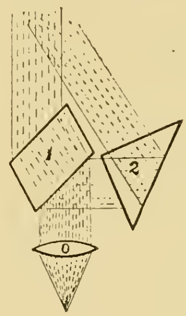

Fig. 2.

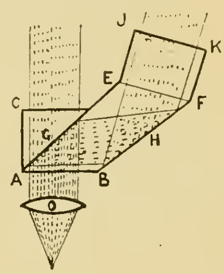

Fig. 3.

is "geometrically" divided, *i.e.*, the beam is bisected and half is directed into each eye. This is accomplished by interposing one or more prisms in the path of the beam as shown in Fig. 1.

This type of instrument involves the use of long tubes and is consequently bulky, resolution is diminished by reducing the size of the beam of light, and it cannot be used with high powers as the dividing prism cannot be placed sufficiently close to the back lens of the objective properly to bisect the beam before the rays have intermingled.

The third form alone embodies correct principles. In this, of which the Powell and Lealand and Abbé are the best examples, the beam of light is not bisected, but is physically sifted or filtered, so that a portion of every part of it goes to each eye. This "sifting" or "filtering" is accomplished in the forms mentioned by interposing in the path of the beam a glass plate or prism which transmits part and reflects part, as shown in Fig. 2 (the Powell and Lealand type) where 1 represents the glass plate, and 2 is a reflecting prism.

In this form resolution is unimpaired, but the instrument is bulky, and there may be a good deal of difference in the amount of light which reaches the two eyes.

A great advance has recently been made in the last-named form by Messrs. Beck, in this country, and Messrs. Leitz, in Germany, by the use of a half-silvered film cemented between two prisms. The silvered film is semi-transparent and allows part of the light to pass through and part to be reflected by the surface of the prism into the second tube.

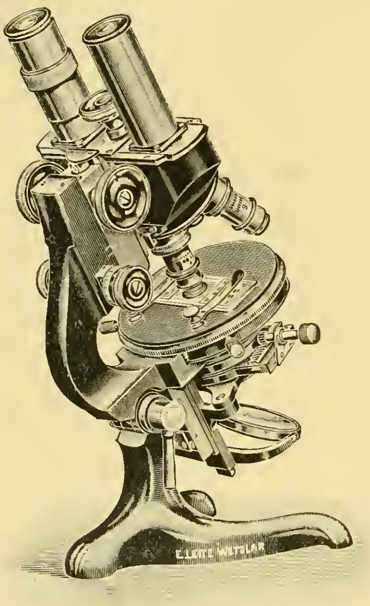

FIG. 4.—The Leitz binocular microscope.

Fig. 3 represents the construction in the Beck model, where EA represents the silvered film between the two prisms.

In both the Beck and the Leitz model, resolution is unimpaired, the illumination in both eye-pieces is the same, the instrument is much less bulky than the old forms, and short tube-lengths can be retained.

There can be no doubt of the superiority of this binocular form over the ordinary monocular microscope. Eye-strain is lessened, and there is an increased "vividity" about the image, even though a true stereoscopic effect is not attained. It is particularly valuable in the examination of objects with dark-ground illumination; more seems to be visible than with the ordinary monocular microscope.

There is an important difference between the Beck and Leitz models in the adjustment of the distance between the two eye-pieces to compensate for the varying distance between the two eyes in different individuals. In the Leitz model (Fig. 4) the tubes carrying the eye-pieces are parallel, in the Beck model they diverge (see Fig. 3). The inter-ocular distance in the former is adjusted by an arrangement which alters the distance between the two tubes; in the latter the inter-ocular distance is varied by lengthening or shortening the diverging tubes. Now the former method entails much less alteration of tube length than the latter, and inasmuch as the best lenses are corrected for a particular tube-length, for critical work we cannot help thinking that the Leitz adjustment is decidedly superior to that which obtains in the Beck model.[1]

R. T. HEWLETT.

THE SCOTTISH ANTARCTIC EXPEDITION.

BRITISH men of science will notice with keen regret the unpromising answer given by the Government to the application for 3,800*l.* to complete the publications of the Scientific Reports of the Scottish National Antarctic Expedition of 1902–1904. The application has been supported by a very influential body of Scottish scientific opinion. The expedition was entirely equipped by money privately raised in Scotland, and was mostly due to the generosity of Messrs. J. and A. Coats. The discovery by the *Scotia* of Coats Land is generally recognised as the most important addition to our knowledge of the boundaries of the Antarctic continent that has been made by the Antarctic expeditions of this century. It added half a million square miles to the previous estimates of the area of the continent and settled the position of the coast in the one part where there was no clue to its situation.

The *Scotia* made a series of voyages in the least known of the Antarctic seas and, as the whole of the energies of the expedition were devoted to scientific work, it made collections and oceanographic observations of the highest importance. Five volumes of its scientific results have been published and three others have been arranged owing to a grant previously made by the Government. Four further volumes are required to complete the series. The remaining volumes would be mainly devoted to description of the biological collections, and the memoirs have been already prepared by many distinguished British and foreign naturalists. The work of these men of science has been entirely gratuitous and it is peculiarly ungracious to the foreign contributors that it should be wasted owing to the lack of the comparatively small sum required to complete the publication. 17,500*l.* has been set apart to defray the cost of preparing the reports on the scientific work of the *Terra Nova* expedition, which excludes the reports on natural history which are being published at Government expense by the British Museum; hence the expenditure on the *Scotia* publications has not been excessive. Much confusion in biological nomenclature may be produced if the publication of these reports be delayed, so that they appear simultaneously with those prepared from the collections of later expeditions.

The application to the Treasury for a grant for the publication of the results has received very influential support; it is accompanied by letters from all the leading scientific societies and authorities in Scotland, and by the past and present

[1] In the preparation of this summary, free use has been made of the articles by Dr. Jentzsch and Mr. Conrad Beck in the Journal of the Royal Microscopical Society, 1914, part 1, pp. 1 and 17. For the loan of the blocks from which the illustrations are reproduced, we are indebted to Messrs. R. and J. Beck and Messrs. E. Leitz.

Presidents of the Royal Society. There certainly seems good grounds for the complaint that the Scottish expedition has not received its fair share of support from the Treasury. It will be lamentable if scientific results of such importance be still further delayed in publication, and it is to be hoped that the Government will give favourable consideration to this reasonable appeal.

NOTES.

We record with deep regret the death in Vienna, on April 25, at eighty-three years of age, of Prof. E. Suess, foreign member of the Royal Society, and emeritus professor of geology in the University of Vienna.

Mr. Herbert Samuel stated in the House of Commons on Tuesday that he is about to appoint a Committee to consider the question of smoke abatement. The names of the members will be announced in a few days.

The April number of *Science Progress* contains an editorial article of nine pages, entitled "Sweating the Scientist." During the past year an inquiry has been conducted by our contemporary as to the emoluments of scientific workers, and the article referred to is a provisional report on the results of this inquiry. As might, perhaps, have been anticipated, the replies received suffice to prove the "low scale of payment given throughout the British Empire for such work." This result is no doubt due to the law of supply and demand, and an interesting sketch is given of the conditions which give rise to such a state of affairs. Other grievances are also dealt with. "Besides the low rate of pay, there are, in this country at least, many small abuses attached to high intellectual work. Large portions of the income of many institutions are given to the maintenance of more or less useless pursuits. Originality and success in research do not receive their due place in selection for appointments. The best-paid posts are seldom given for the best work done, but rather for qualities which are of little account—popularity, eloquence, text-book knowledge, private influence, and skill in the arts of time service. We appear to judge men, not by the work which they have done, but by the work which we may imagine, from their appearance, that they may do." The lack of financial support afforded by the Government to the higher forms of intellectual effort and to higher education is also criticised. The article is a timely one, and deserves the careful attention of all scientific workers, as the question of remuneration is one of paramount importance to the future welfare of science in this country. Particular reference is made to the unpaid services of men of science upon Government Committees, and to the custom of Government departments going to learned societies for expert advice for which no payment is made. "In other words, the State exploits the man of science on account of his enthusiasm for his work and his patriotism." The whole subject is one which the British Science Guild could take up appropriately and refer to a committee.

Dr. Basil T. Parsons-Smith has been awarded the Hunterian Society's medal for his essay, "The Intermittent Pulse."

We learn from the *British Medical Journal* that sufficient funds have now been collected for the erection at Verona of a memorial to Prof. Cesare Lombroso. It is hoped that the monument (which will be the work of Leonardo Bistolfi) will be unveiled in 1915 at the time of the International Congress on Pellagra, which is to be held at Verona.

On Tuesday next, May 5, Prof. W. Bateson will deliver the first of two lectures at the Royal Institution on (1) double flowers, (2) the present state of evolutionary theory, and on Saturday, May 9, Prof. C. J. Patten, of Sheffield University, will begin a course of two lectures on bird migration. The Friday evening discourse on May 8 will be delivered by Prof. Karl Pearson on albinism in men and dogs, and on May 15 by Prof. F. Keeble on plant animals: a study in symbiosis.

The council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1913–14:—A Telford gold medal to Mr. F. W. Cowie (Montreal); a George Stephenson gold medal to Mr. F. E. Wentworth-Sheilds (Southampton); Watt gold medals to Mr. Thos. Clarkson (Chelmsford), and Mr. Henry Fowler (Derby); and Telford premiums to Prof. E. G. Coker (London), Mr. W. A. Scoble (London), Mr. Wm. Willox (London), and Mr. S. P. W. D'Alte Sellon (London).

In the House of Commons on April 22, Mr. Astor directed attention to the unsatisfactory state of legislation and administration with reference to the supply and sale of milk and cream in the United Kingdom; and moved "That fresh legislation is needed to control the supply and sale of milk and cream in the United Kingdom, and that the existing laws should be more thoroughly administered." Mr. Herbert Samuel, in reply, stated that the Board of Agriculture is about to issue a new Order granting more generous compensation to the farmers for the cows slaughtered for the purpose of checking the spread of tuberculosis, and that local authorities are to be assisted in the administration of the law. He further stated that he hopes shortly to introduce a Milk and Dairies Bill, more restricted than its predecessors, which will substitute for various codes now administered by local authorities the uniform provisions of a general statute. He is anxious not to disturb the dairying industry, or to raise the price of milk, and the Bill will be framed in that spirit.

Final arrangements are now being made for the International Congress of Tropical Agriculture, which is to be held in London at the Imperial Institute in June next, under the presidency of Dr. Wyndham Dunstan. Invitations to take part in the congress have been issued to foreign countries by H.M. Secretary of State for Foreign Affairs, and already many foreign Governments have nominated delegates to represent them at the congress. The cooperation of many planters' associations, commercial museums, chambers of commerce, Colonial societies, and similar bodies in this country and abroad has also been secured, and it is already known that at least forty countries will be represented at the congress, ranging from our nearest neighbour France, to such remote places as Formosa, Hawaii, and Papua. A notable feature of the congress will be the organised discussions on certain questions of outstanding importance to tropical agriculture. Four of these have been arranged, viz., technical education in tropical agriculture; the organisation of tropical agricultural departments in relation to research work; the defects of plantation rubber and the means of avoiding them; and problems of cotton cultivation. The fact that the British Cotton Growing Association, the International Federation of Cotton Spinners, the Egyptian, Indian, Nyasaland, Uganda, and Nigerian Government Departments of Agriculture, and the German Colonial Economic Committee have each deputed officials to contribute papers in the discussion on problems of cotton cultivation, indicates the success attained by the organising committee for the congress in securing competent exponents of different points of view on these questions. Full particulars of these and other arrangements for the congress are given in the preliminary general circular and the members' circular, copies of which can be obtained on application to the congress secretaries (Dr. T. A. Henry and Mr. Harold Brown) at the Imperial Institute, London, S.W.

In the second part of *Ancient Egypt* Prof. Flinders Petrie, the editor, discusses the question of so-called "mummy wheat." At Hawara in the Fayum he discovered a large store of corn of the Roman period, some of which was sown, but failed to germinate. The "mummy wheat" legend is based on various accidents: some dealers in Thebes sell little pots of ordinary corn to tourists; Sir Joseph Hooker noticed accidental admixture of fresh raspberry seeds with some found in the Laurion Mine; there is, lastly, the desire of the gardener to make the experiment successful. Doubtless from time to time the story of the germination of "mummy wheat" will be told, and only credulous people will continue to believe it.

In the Museum Journal of the University of Pennsylvania for December last Dr. Edith H. Hall describes a fine collection of ancient glass, recently increased by numerous specimens from graves in Palestine and Italy. It includes fine examples of the primitive type, in which the decoration was achieved by laying threads of variously coloured glass over the surface of the vase while it was still hot, and then rolling the whole upon a smooth stone until the threads were pressed in. Besides these there is a good series of Roman mosaic glass, of which the best are the *millifiori* bowls, so called by the Venetians who valued them highly. The rapid increase of the art collections in this museum, due to the wise expenditure of its income and the munificence of American citizens, is noteworthy.

A large portion of the April number of the *Irish Naturalist* is devoted to a memoir, with portrait, of the late Major G. E. H. Barrett-Hamilton, by Mr. C. B. Moffat.

To the first part of vol. xxxvi. of Notes from the Leyden Museum, Dr. J. H. Vernhout contributes an article on the land and fresh-water molluscs of Surinam, or Dutch Guiana, a subject which has hitherto received but scant attention at the hands of naturalists, the only complete list being one published by van Martens in 1873. Many new species are described in the part now issued.

At the conclusion of an article in the April number of the *American Naturalist*, by Dr. A. F. Shull, on the biology of the Thysanoptera (thrips, etc.), it is stated that *Anaphothrips striatus*, hitherto known almost exclusively by females, recently produced about 25 per cent. of males at Douglas Lake. This suggests that the theory of an alternating life-cycle in this and certain other members of the group, which was at one time formulated but subsequently rejected, may have some measure of justification.

In the February number of the *American Museum Journal* Dr. F. A. Lucas concludes his account of groups of animals in museums, with reproductions from photographs of a large number of the most striking examples selected from various American museums. Among these, the great albatross colony on Laysan Island in the State University of Iowa and the scene illustrating North American mammalian life in the museum of Kansas University are perhaps the most wonderful. Nothing approaching them is to be seen in any English museum.

The thorough and exhaustive manner in which the German Government explores its colonial possessions in Africa is well exemplified by *Ergänzungsheft*, No. 9*a*, of *Mitteilungen aus den Deutschen Schutzgebieten*, which is devoted to the topographical results of several exploring expeditions in the southern and eastern Cameruns, as well as of one in Togo. Members of the various exploring parties have contributed their own notes, well illustrated with photographs of scenery, these notes including remarks on the anthropology, zoology, and botany of the districts traversed.

With the view of improving the Zoological Gardens under his care at Giza, Egypt, Captain Stanley Flower made a tour of inspection of the establishments of a similar or kindred nature in India during 1913, the results of which are published, with a number of interesting illustrations, in a Report on a Zoological Mission to India, issued by the Ministry of Public Works, Egypt, as No. 26 of the Zoological Service Publications. The author observes that in every zoological garden visited in India there were features of interest, and in each there were new facts of menagerie-technique to be learnt. The gardens at Calcutta were notable for the extent of the collection, those at Trivandrum for the scientific method on which they are arranged, and those at Peshawar for the splendid condition of the animals.

Optimism pervades the report of the council of the Zoological Society for 1913, the total number of fellows and the income from their subscriptions continuing to show a steady increase, while the receipts for admission at the gates of the gardens were the highest on record. The year will be notable for the commencement of the "Mappin Terraces" in the gardens, now nearing completion, and also for the preparation and acceptance of a general plan, made under expert advice, for improvements in the arrangement of the gardens as a whole. These alterations, which have become imperative owing to the increasing popularity of the gardens, will involve the abolition of the old bear-terrace, which, although one of the landmarks of the gardens, is now hopelessly antiquated and out of date. It is satisfactory to learn that plans for new and up-to-date salt- and fresh-water aquaria are under consideration. Neither has the scientific side of the society's work been neglected, special attention being directed in the report to the society's share in the new mammal survey of British India, which has already resulted in the discovery of one new genus and several new species of rodents.

In the twenty-seventh annual report of the Marine Biological Station at Port Erin, Prof. B. Moore and his co-workers have summarised important observations on the hydrogen-ion concentration of sea-water, determining its degree of alkalinity or acidity, which does not remain constant throughout the year but varies with the relative activities of vegetable and animal organisms, and acts as an index to these activities. There are two maxima of alkalinity corresponding to the two seasonal outbursts of diatoms. The change observed indicates a synthesis, at these seasons, of some tons per acre of sea-water of organic vegetable matter for the nutrition of the animals. The green plants or diatoms break up the bicarbonates present in sea-water and form organic compounds, the amount of the removal of the carbon dioxide being shown by the increase in alkalinity in the water. It is noteworthy that the spring increase in alkalinity is just of the grade formerly found to be most favourable to the rapidity of cleavage in the initial stages of development of the eggs of the sea-urchin (Echinus).

A recent issue of the *Naturwissenschaftliche Wochenschrift* (March 15, 1914) contains an article by Dr. F. Stellwaag, of Erlangen, in which he directs attention to the apparently contradictory results obtained by various observers who have experimented on the colour-sense of bees. Following the methods of Lord Avebury and of Forel, von Dobkiewicz came to the conclusion that bees are able to distinguish between colours, but are only attracted by them when they have learnt by experience to associate a given colour with the presence of honey. This he considers to accord with the fact remarked by Plateau that many colourless and inconspicuous flowers are eagerly sought after by bees, while many brightly-coloured flowers are unvisited by them. These results were to some extent confirmed by von Frisch, who concluded further that the colour-vision of bees must resemble that of "red-blind" men. Hess, however, disputes the conclusions of both preceding experimenters, and considers that bees show no indication of being otherwise than totally colour-blind. Stellwaag himself is of opinion that in all these experiments an important factor has been overlooked, viz. the condition of the bees with regard to the general supply of provender. When this is deficient, bees will seek it anywhere.

An interesting paper has been issued by W. E. Castle and J. C. Phillips in Publication No. 195 of the Carnegie Institution of Washington (1914), on the effects of selection in modifying the pattern of piebald rats. The piebald or "hooded" pattern behaves as a Mendelian recessive to the self-coloured condition, but within the hooded class there is considerable variation in the extent of the coloured areas. The authors have made continuous selection experiments, both in the direction of greater and of less pigmentation, extending over thirteen generations and involving the breeding of some 25,000 rats. Although the hooded pattern behaves as a Mendelian unit, selection of either plus or minus variation brought about permanent changes extending far beyond the original variation of the race. In each generation the offspring of selected parents tended to regress towards the mean of the preceding generation, with the result that when, after several generations of selection, the selection was reversed, the regression was *away* from the original mean. But by continued reversed selection from a race which had become very divergent, the mean was brought back nearly to the original starting point. Results are described of crosses between extreme plus and minus strains, and between such strains and self-coloured types. An account is also given of an extreme variant which appeared as a mutation. The paper should be compared with the recent work of Hagedoorn (*Zeitsch. indukt. Abstam.*, xi., 1914, p. 145).

A detailed account of the twelve months' poultry laying competition at the Harper Adams Agricultural College is given in the report of the college for 1913. Upwards of six hundred birds were tested, the average egg production being 152 for the twelve months period. A comparison of the returns obtainable from one acre of grass land when stocked entirely with poultry and the same area used for milk production, shows that a much greater return per acre can be produced in the former case, these being respectively 41*l.* 13*s.* 4*d.* and 4*l.* 3*s.* 2½*d.* It must be borne in mind that, although the gross return per acre in the case of the poultry is so much greater than for cattle, the expenses, capital and depreciation of stock, would be correspondingly high. Unfortunately, there seem to be no available figures which might be utilised for purposes of comparison. That the possibilities of egg production on commercial lines are great cannot be denied, and the actual determination of these, and the factors which govern such production, should prove an interesting and profitable field for further investigation.

A report on sugar cane experiments in the Leeward Islands which has just been published, contains a summary of the varietal trials and work on manuring conducted during the last few years. Of the varieties which have been under cultivation for some considerable time, and of which the relative merits and suita bility to various conditions are well appreciated and recognised, Sealy seedling and B 147 have attained considerable popularity, while the more recently introduced varieties, B 4,596 and B 1,528, are more prominent. The importance of incorporating with the soil a sufficiency of organic matter, either as pen-manure or green crops, is becoming more and more recognised, and the various bacterial changes concerned in the breakdown of these manures are discussed in this report in the light of recent investigations. The extreme rapidity with which such changes proceed in tropical climates is indicated by the fact that under favourable conditions the humus content of the soil may be decreased by as much as 25 per cent. in the space of six months.

SOME interesting observations on the action of thunderstorms in giving rise to seiches have recently been made by Messrs. Okada, Fujiwhara, and Maeda (Proc. Tokyo Math. Phys. Soc., vol. vii., 1914, pp. 210–221). The measurements of the seiches were made with a Honda limnimeter on the shores of Lake Biwa in central Japan. The authors indicate as important causes of seiches during thunderstorms the accumulation of rain-water over a portion of the lake, the impulsive action of winds on the surface, and sudden changes of barometric pressure; and as subsidiary causes the impact of falling raindrops on the surface of the lake and the attraction of the electrified mass of thunderclouds. They examine in detail the effects of a heavy thunderstorm that swept over Lake Biwa on April 19, 1912, and estimate that the change of barometric pressure (2·7 mm.) would account for an amplitude of 6·6 cm. in the seiches, the rainfall (32 mm. in twenty minutes) for an amplitude of 6·1 cm., while the impulsive action of the wind may have contributed an amplitude of 4·5 cm. The sum of these amplitudes is 17·2 cm., which is very close to the total amplitude observed

THE two last contributions to the geology of the Antarctic Expedition of the *Belgica* ("Expédition Antarctique Belge: Résultats du Voyage du s.y. *Belgica* en 1897, 1898, 1899; Zoologie, Tuniciers, Caducichordata," by Ed. van Beneden and Marc de Selys-Longchamps, 1913; and "Géologie, Petrographische untersuchungen der Gesteinsproben," part ii., by Dragomir Sistek, 1912) include the account of the tunicates and a further contribution to the description of the rocks collected. The memoir on the tunicates was begun by E. van Beneden, and after his death was continued and completed by M. Marc de Selys-Longchamps. The expedition obtained eight species, of which five are new and another is represented by a new variety. All the species collected have been described in elaborate detail; the memoir comprises 120 pages, and is illustrated by seventeen plates and some figures in the text. The classification adopted is that by Hartmeyer. The new contribution on the petrography of the expedition is a description by D. Sistek of the rocks collected in the Straits of Magellan and the Beagle Channel, which is on the southern side of Tierra del Fuego. The rocks are all igneous or metamorphic. The most varied collection, including granite, diorites, quartz-porphyries, andesite, diabase, basalt, gneiss, schists, and clay slate, was made at Cape Gregory in the Straits of Magellan. The crystalline schists include a varied series. The chief rocks are illustrated by a plate of microphotographs of unusual clearness.

AN important by-product of the adjustment of the primary triangulation of the United States was the discussion of the deflections of the vertical and anomalies of gravity, by Mr. J. E. Hayford, on the hypothesis of isostatic compensation of inequalities of the earth's surface. In this way the discrepancies between the observed and the anticipated values of each was very largely reduced, but, whatever the precise form of hypothesis used, there still remained an average anomaly of gravity of not less than 0·020 dyne, which was attributed by Mr. Hayford to an imperfection of isostatic adjustment. Prof. G. K. Gilbert has taken up the subject in Professional Paper 85–C of the U.S. Geological Survey, and shows that the distribution of the anomalies of gravity does not indicate any relation to the leading features of geological structure, as would be expected if they were due to variation in the distribution of density, or imperfect isostatic adjustment, within the earth's crust. From this he concludes that they are due, at least in part, to variations in the nuclear portions of the earth, below the limits within which isostatic adjustment, and compensation of elevated tracts of the earth's surface, take place.

PROF. G. A. GIBSON, of Glasgow, has issued in separate pamphlet form the address he recently gave before the Royal Philosophical Society of Glasgow on Napier and the invention of logarithms. The pamphlet contains a clear picture of the career and personality of the great Scottish mathematician, bringing together within the compass of twenty-four pages the salient facts of his life. The interest for the mathematical student is the account given of the way in which Napier originally defined the logarithm. This does not correspond exactly with what is known as the Napierian logarithm, although it is closely related to it. There is a passing reference to Bürgi, whose "Progress Tabulen" has probably been seen by very few mathematicians in this country. The evidence that Napier was in possession of his method at least twenty years before he published his tables is also referred to; and Napier's other mathematical and arithmetical discoveries have as adequate a notice as is possible in such a brief statement. Prof. Gibson's sketch comes at an opportune time when mathematicians are preparing to celebrate the tercentenary of the publication of the "Canon mirificus logarithmorum."

A PAPER by Messrs. K. M. Faye-Hansen and J. S. Peck, published in the last issue of the Journal of the Institution of Electrical Engineers, deals with some interesting uses of inductance coils or "reactances" in heavy electrical engineering. These are being used to an increasing extent on large power supply systems of the order of 100,000 kilowatts for the purpose of limiting the current that may flow in various parts of the circuits in cases of accidental short circuits with the view of localising the damage that can be done. For example, it is possible by placing reactances in the conductors between the generators and the switchboard, to limit the current under conditions of short circuit on the switchboard or feeders to, say eight times, the normal working current, and thus to protect the machines from enormously greater rushes of current that would be destructive. The paper discusses the relative utility of such reactances in the generator leads, in the feeders, and between different sections of the main "bus-bars," and suggests various combined arrangements. These reactances generally take the form of large coils without iron in their magnetic circuit, but a partial iron circuit is sometimes employed. An appendix discusses the effect of bus-bar reactance on the parallel operation of alternators.

IN twelve pages of the March number of the Journal of the Franklin Institute Mr. W. P. Davey, of the X-ray laboratory, Cornell University, succeeds in giving a most valuable summary of the present state of our knowledge of Röntgen, or X-rays. After explaining the production of Röntgen rays by the impact of kathode rays on the target of a vacuum tube, he shows that they produce fluorescence in certain bodies on which they impinge, they affect photographic plates and ionise the air through which they pass. In each case the laws which have been found to hold are stated. When the rays fall on metals or on metallic salts they produce in certain cases secondary radiations which differ in properties from the original rays, and by analogy have been called fluorescent Röntgen or X-radiations. The methods adopted for the measurement of the quality or penetrating power of the radiations, and the quantity of radiation which falls on a given surface in a given time, are also described. The article will prove of great value to those who wish to make themselves acquainted with the principal facts of the subject without entering into details.

THE Société de Chimie-Physique has issued two more numbers of its series of monographs. These are vii., "Paramagnetism Applied to the Study of Metallic Salts," by Mlle. E. Feytis; viii., "Relations between Chemical Constitution and the Coloration of Organic Substances," by M. André Meyer. The latter contains, in addition to a review of the chief types of coloured compounds, a bibliography of the subject extending over ten pages, and containing more than two hundred references to original papers.

AN interesting illustrated article on charcoal burning in the Weald, by Mr. W. R. Butterfield, is contained in the April number of the *Selborne Magazine*. This primitive industry is still carried on in the Weald, although it has declined considerably during the last thirty years, owing to the decreased quantity of home-grown hops, for the drying of which the charcoal is mainly used. All the charcoal that is required is made during the few weeks before hop-picking, and the "collier," as the burner is called, and his mate move from farm to farm as required, and cover a wide area each season. The burners depend wholly upon empirical knowledge, either acquired by their own experience or handed on to them by their predecessors, and the operation is one requiring considerable skill and unremitting vigilance day and night.

THERE is an interesting illustrated article in the *Engineering Magazine* for April, giving an account of the workshops and methods of the Ford Motor Company. This company turns out 1000 automobiles a day at its Highland Park Works in Detroit. The other two factories belonging to the company, one at Ford, Ontario, Canada, and one at Manchester, England, bring the total Ford car-producing capacity to at least 1200 cars a day. The company produces one article only, viz., the Ford motor-car, and employs rather more than 15,000 hands.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MAY:—

May 1. 11h. 24m. Neptune in conjunction with the Moon (Neptune 4° 17′ S.).
,, 20h. 43m. Mars in conjunction with the Moon (Mars 1° 37′ S.).
15. 7h. 4m. Uranus in conjunction with the Moon (Uranus 2° 3′ N.).
16. 1h. 50m. Jupiter in conjunction with the Moon (Jupiter 1° 13′ N.).
,, 2h. 7m. Venus in conjunction with Saturn (Venus 2° 10′ N.).
,, 20h. 0m. Uranus stationary.
,, 23h. 0m. Mercury in superior conjunction with the Sun.
25. 23h. 5m. Saturn in conjunction with the Moon (Saturn 6° 9′ S.).
26. 21h. 2m. Venus in conjunction with the Moon (Venus 3° 21′ S.).
28. 17h. 57m. Neptune in conjunction with the Moon (Neptune 4° 1′ S.).
30. 5h. 16m. Mars in conjunction with the Moon (Mars 0° 42′ S.).
,, 10h. 0m. Mercury at greatest heliocentric latitude N.

COMET 1914A (KRITZINGER).—Recent observed positions of comet 1914*a* (Kritzinger) have enabled Prof. Kobold (*Astronomische Nachrichten*, No. 4729) to improve the elements of this comet, and consequently the ephemeris. The new positions for the current week are now as follows:—

12*h*. *Berlin M.T.*

	R.A. (h. m. s.)	Decl. (° ′)	Mag.
April 30	18 13 21	+16 30·7	8·6
May 1	17 56	17 31·9	
2	22 34	18 32·8	
3	27 14	19 33·3	
4	31 55	20 33·3	
5	36 39	21 32·6	
6	41 23	22 31·2	
7	18 46 9	+23 29·0	8·5

The comet is situated in that portion of the constellation of Hercules lying to the south of Vega, and it will be noticed that the present calculation makes the object brighter by more than half a magnitude than that previously given.

THE APRIL METEORIC SHOWER.—Mr. W. F. Denning writes:—More favourable weather for meteoric observations could scarcely have occurred at the period of the Lyrid meteors. At Bristol the fourteen successive nights from April 10 to 23 were clear or generally clear throughout. The expected shower of meteors, however, failed to display itself in a prominent manner. There were a few bright Lyrids seen between April 19 and April 22, but the return of this year must certainly be classed among the failures. A number of other streams showed themselves in the absence of the major shower, but meteors were rather scarce generally, with a great exception on one night, April 22, when they were quite abundant, though the Lyrid display was scarcely visible. On April 14 there was a remarkable dearth of meteors before midnight, though the firmament was splendidly clear.

Mr. Denning has computed the real paths of several interesting meteors recently observed at two stations:—

1914 April	G.M.T. h. m.	Mag.	Height at first. Miles.	Height at end. Miles.	Path. Miles.	Velocity per sec. Miles.	Radiant Point. ° °
12	10 5	2–1	64	44	21	18	167+31
15	9 46	4–2	88	64	49	35	309+61
,,	10 22	2–1	71	55	18	36	180+77
,,	10 44	1	73	57	29	29	312+61
20	11 7	>1	62	48	57	29	319+40
22	10 51	2	76	44	76	24	238–2

The chief radiant points have been:—

° °			° °
142+27	...	...	220+13
199+ 7	...	...	239± 0
204+55	...	...	272+33
209–10	...	...	312+61

The Aquarid meteoric shower, supposed to be connected with Halley's comet, is due to reappear on the mornings of May 1–6. The radiant point is at about $337^\circ-2^\circ$.

THE PRESSURE IN THE REVERSING LAYER OF THE SUN.—In an early number of a Bulletin of the Kodaikanal Observatory (No. 18) Mr. Evershed attempted to make a rough estimate of the pressure in the reversing layer of the sun based on the assumption that those lines which were most and least affected by pressure in the laboratory were similarly affected in the sun. In a more recent Bulletin (No. 36) he suggests a new interpretation of the general displacement of the lines in the solar spectrum towards the red. He shows that taking into consideration probable differences of level, the absolute and relative shifts can be quite easily explained as due to motion in the line of sight, and have very little relation to pressure shifts. While the quantities measured are exceedingly small, and, as he says, subject to considerable errors, yet he is so convinced that pressure is not the main factor involved that he publishes his results, even although all the work of measurement is not yet completed, and exact values cannot be submitted. Many interesting points are mentioned in the paper, one being that a small pressure effect is traceable in the relative positions of the solar and arc lines, but that it is a minus effect, thus indicating a decidedly smaller pressure in the sun than in the arc in air. With such a small pressure effect he finds the shifts closely related to the intensities of the lines, the strong lines showing larger shifts than the weak. He arrives also at the conclusion that in the higher levels of the sun there is a movement of descent which is retarded in the lower levels.

THE NEW UNIVERSITY OF ZÜRICH.

ON the four days from Friday, April 17, to Monday, April 20, Zürich celebrated in a very interesting fashion the inauguration of the new University which for six years she has been engaged in building at a total cost of 5,600,000 francs (224,000*l.*). As is usual on such occasions, the guests were welcomed at a reception in their honour on the Friday evening. The *Weiheakt* of Saturday morning was held in the central court of the new University, which is covered with a roof of tinted glass carried on light iron girders. Thither the University authorities and their guests marched two and two from the Kunsthalle, the procession rendered picturesque by the robes of the foreign delegates, for the republican simplicity of Switzerland does not admit of academic dress. Many speeches were delivered, those of the local officials naturally dwelling upon the efforts required to complete the task. Amongst those of foreign delegates that of Dr. Macan, master of University College, Oxford, was distinguished by its wit and humour, and by the obvious pleasure which it gave to the people of Zürich where he had been a student thirty-nine years before.

The speeches were followed by a cantata written by Prof. Alfred Frey, and set to music by the director of the Conservatorium, Dr. Hegar. Both words and music were well adapted to the occasion, most parts of the libretto attaining a high poetic level. A banquet lasting nearly four hours followed, and for those who wished for more festivity still there was a students' *kommers* in the evening. Sunday was no less full, with a special service in the Fraumünsterkirche, a luncheon given by the Guild of Smiths, a trip on the lake, and an admirable performance of Gluck's "Orpheus," in the Stadt-Theater in the evening. Monday was the annual festival of the *Sechseläuten*, where, as of old, the departure of winter was betokened by the burning of a huge puppet filled with fireworks at the end of a procession through the town which lasted the whole afternoon. This year the procession was developed into a gorgeous pageant of the history of learning from its beginnings in Egypt and Babylon, through Greece and Rome, troubadours and goliards, monks and reformers, to the present day. In the evening the trade guilds had their separate banquets, to which visitors were invited. The entertainment was followed by visits from the younger members of one guild to each of the others in turn. As they came in with their band and banner, with lanterns hanging from long poles, and the emblems of their craft, while their leader exchanged loving-cups with the master of the guild visited, and the two made, and in turn listened to, speeches at one another's expense, one felt that one had here a custom which had known no change since at least the fifteenth century.

Nothing could exceed the hospitality and kindness with which the foreign visitors were welcomed. As a means of identification the guests were asked to wear in the buttonhole a stud with the colours of Zürich (light blue and white), which proved a most useful "open sesame" everywhere.

This is the third time that the University of Zürich has been furnished with buildings since its revival in 1833. The intermediate edifice was built in 1864. For some time back the University has shared in the building occupied by the Polytechnic, but by 1907 it was felt that the difficulties of accommodation must be otherwise provided for. In 1908 architects were invited to compete, and ultimately the plan of the firm of Curjel and Moser, of St. Gallen and Karlsruhe, was adopted. The site on the Zürichberg was not easy, because the slope is very considerable, and from parts of it various other institutions had to be removed. The buildings, which, of gray stone and many windowed, resembles many Germany university buildings, consists of two wings with a great tower between. The northern and lower wing is the biological institute, the southern is the University proper, in the sense that it contains the lecture-rooms, reading-rooms, *seminars*, libraries for the theological and arts faculties, and accommodation for the administration. To it also have been moved the archæological and ethnological collections. Natural science and medicine are provided for in the biological institute and in other buildings adjacent.

Apart from the tower, the building is in three storeys at present, though in the University proper it will be possible, as the numbers increase, to provide more accommodation for classes in the attics. With an imposing façade on two sides, the rooms are admirably lighted. Round the central court runs a wide passage on each storey, thus giving easy access from room to room, and also providing in these passages, which can be seated, excellent galleries for such occasions as that of April 18. The parapet towards the court is broken by openings, the superincumbent mass being on the first storey supported in each case by two Moorish pillars. In the storeys above are romanesque arches, so that the appearance towards the inner court is more like that of some southern palazzo than could be guessed from its external aspect. The effect is heightened by the insertion in the walls of small artistic figures. The rooms for the administration are well furnished; the desks and seats in the lecture-rooms are substantial but simple.

On the walls of the galleries are frescoes which the spectator was asked by notices to believe were not yet finished, and which seemed, truth to tell, to represent an early stage of art. But the general effect of lightness and airiness was excellent, and the people of Zürich and their architect, Mr. Moser, are to be congratulated on the way in which they have secured an admirable result at what, for the accommodation provided, seems a minimum of cost. It is to be remembered that the whole of this is paid for out of the rates of the Canton of Zürich, which not unnaturally are very high. But as the inscription above the entrance tells us, all has been done "by the will of the people," which, when the first credit was insufficient, voted a second. The people of Zürich are convinced of the value of good and cheap education, and nothing in the whole celebration perhaps was more interesting than to mix with the crowd on Monday morning, when the building was thrown open to the public, and to hear the approving remarks of tradesmen and labourers as they examined the new building which they were proud to call their own. G.

RADIUM AND QUACK MEDICINES.

IN view of the fact that a large number of drugs, earths, and waters, said to be radio-active, are being offered for sale to the general public for the treatment of certain diseases, the medical committee of the British Science Guild recently instituted an inquiry into the question of radium and its therapeutic uses.

The result of the inquiry indicates the urgent necessity for legislation in order to safeguard the interests of the community in the sale of these substances, by compelling a written guarantee to be given as to the quantity of radium present in the substances offered for sale.

The use of radium in cases of cancer is now widely known, but it is necessary to warn the public that no definite evidence that cancer is permanently curable by radium is yet forthcoming. The immediate effect of the treatment of cancer by radium is often highly satisfactory, but it must not be forgotten that agents other than radium are known to give equally good results. It is only by keeping under observation for at least five years patients who have been so treated that a definite decision can be come to as to the place radium-therapy shall take in the treatment of malignant diseases.

The great strides that have been made in recent years in the use of radium for the treatment of disease, and the results obtained, encourage the medical profession to persevere with this therapeutic agent. However, radium in its application to disease is still but little understood, and until more experimental, pathological and clinical data have been collected to show the effect of this agent upon, not only the diseased but also the healthy tissues of the body, dogmatic statements as to its therapeutic value cannot be made.

In these circumstances of uncertainty the public is warned that there is danger that the claims which have been advanced for radium as a curative agent may lead to frauds on the credulous section of the public, which may be imposed upon by the sale of substances or waters in which radium does not exist, or may be harmfully treated by persons with no medical qualifications.

The inclusion of radium in the Pharmacopœia would be of material benefit to the public, and it is proposed to take the steps necessary to secure this end. It has also been suggested that radium should be scheduled as a poison under the Foods and Drugs Act, which would be an additional safeguard against the victimisation of the public.

The report of the medical committee of the British Science Guild contains further valuable and important information concerning the sources, etc., of radioactive substances, the price of radium, and diseases which are treated with radium, and this will be published in full in the annual report of the guild, to be issued in May next.

JAPANESE FISHES AND NOMENCLATURE.

THE latest part of the Journal of the College of Science in the Imperial University of Japan (vol. xxxiii., article 1, March, 1913) is a catalogue of the fishes of Japan, by David Starr Jordan, Shigeho Tanaka, and John Otterbein Snyder. It consists of 497 pages, and has 396 figures in the text. There is a very excellent index, and the volume is one which is likely to be of considerable assistance to ichthyologists. The list is based on the work of Temminck and Schlegel (1848 to 1850), on the collections made by David Starr Jordan in 1900. the collections of Snyder (1906), and the collections in the Imperial University of Japan, and the Imperial Museum at Tokyo. It includes all records of Japanese fishes made up to February 1, 1913.

The fish fauna of Japan appears to be an extraordinarily rich one, for the present list deals with 1230 species, while it is pointed out that many additional species from the tropics may yet be found in the Kuroshiwo (that is, the Japan current corresponding to the Atlantic Gulf Stream); the deep-sea species are yet imperfectly known; and large accessions to the lists may be expected when Hokkaido is explored. Japanese names are given for all the species, but full synonymies are not given, and this is occasionally rather troublesome to the worker unaccustomed to the light-hearted manner in which the American systematists play fast and loose with generic names, and their uncompromising insistence on the rules of priority with regard to specific names.

One example from this catalogue may be given—it is not the only one that might be quoted in illustration of our complaint; the Japanese sardine called "Iwashi," was described by Schlegel in 1846 as *Clupea melanosticta*, and this name was adopted by Günther. Richardson also described the same fish in

1846, calling it *Clupea caeruleovittata*, but Schlegel's description appeared on p. 237 of his book, while Richardson's appeared on p. 305 of *his* book. Therefore Schlegel's name has "page priority." But in 1901 Jordan and Snyder changed the generic name from Clupea to Clupanodon; and then in 1906 Jordan (the same worker) and Herre changed it from Clupanodon to Sardinella. In the present paper Jordan, Tanaka, and Snyder discard Sardinella and go back to an old generic name Amblygaster, used by Bleeker in 1849. So it remains for the immediate present.

Of course, irritating as all this is, one cannot but feel that a rigid adherence to the rules of priority (provided that systematists can agree about these) is the only way by which we can approach finality in matters of nomenclature. The case is different, however, with regard to generic and family names, and one may reasonably urge that so long as large tracts of the earth are imperfectly explored, and so long as accessions to specific lists may be expected, the older generic names should be retained. Even should the genus attain "unwieldy" dimensions, it may be broken up into divisions of a provisional nature, but the temptation to make new genera might be resisted, for as a rule these generic changes only burden the synonymies. When the same author places a species in three genera, almost within the same decade, one does not feel confident that the state of our knowledge justifies the adoption of the rather fine distinctions on which these groupings depend. J. J.

THE CANADIAN ENTOMOLOGICAL SERVICE.

THIRTY years ago, in 1884, the Canadian Government appointed a Dominion Entomologist to advise agriculturists and others regarding the control of insect pests. Two years later, on the establishment of the experimental farms system, Dr. James Fletcher, who occupied the position, was attached to the new branch of the Department of Agriculture in the joint capacity of entomologist and botanist, which position he occupied with conspicuous success until his death in 1908. The growth in importance of the subjects necessitated their separation, and accordingly divisions of entomology and botany were created. Dr. C. Gordon Hewitt was appointed Dominion entomologist in 1909, and entrusted with the work of organising the new division of entomology of the Experimental Farms Branch of the Department of Agriculture, with offices and laboratory at the Central Experimental Farm, Ottawa.

The urgent need of legislation in order to permit action to be taken to prevent the introduction into Canada and spread within the country of serious insect pests and plant diseases was responsible for the passage of the Destructive Insect and Pest Act in 1910. The still greater need of investigations on the insect pests affecting agriculture, forestry, and other branches of human activity has led to the establishment of field or regional laboratories in different parts of Canada, with trained entomologists in charge to study local problems.

Owing to the consequent expansion of the entomological work along investigatory and administrative lines, and the fact that such work did not constitute a necessary part of the work of the experimental farms system, and executively was virtually distinct, the Entomological Service has now been separated from the Experimental Farms Branch, and has been constituted an independent branch of the Department of Agriculture under the direction of the Dominion Entomologist. It is proposed to erect a building to provide offices and laboratories for the new entomological branch. Correspondents are requested to note that all official communications and publications should be addressed to "The Dominion Entomologist, Department of Agriculture, Ottawa"

This reorganisation, which will also include the establishment of a national collection of the insects of Canada in the Canadian National Museum (the Victoria Memorial Museum) at Ottawa, under the care of the Dominion Entomologist, marks an important step in Canadian entomology. It will result in a still greater development of the study of Canadian insects along scientific and practical lines.

DISEASES OF PLANTS.

DR. G. H. PETHYBRIDGE, economic botanist to the Department of Agriculture and Technical Instruction for Ireland, has recently published two papers, of considerable scientific as well as economic interest, on species of the genus Phytophthora, and the diseases which these fungi cause in the potato. In the first paper (Sci. Proc. Royal Dublin Soc., vol. xiii., No. 35) he describes the rotting of potato tubers by a species of Phytophthora having a method of sexual reproduction hitherto undescribed, and gives in the introductory portion of the paper a useful summary of the literature dealing with the chief forms of rot previously known to occur in the potato tuber. The new form of rot ("pink rot") is caused by the new fungus *Phytophthora erythroseptica*, the most peculiar feature of which is the fact that the oogonium rudiment enters the antheridium at or near its base, the female organ then growing up through the male and out at the top, expanding there to form the oogonium proper in which the oosphere develops. The "pink rot" disease is prevalent in the west of Ireland, and the losses caused by it, which are considerable, and in some cases being greater than those due to *P. infestans*, are greatest in crops grown continuously on the same land (infection taking place from the soil), and can be avoided by a proper rotation; it is probably transmitted to some extent by oospores which adhere to the seed tubers.

In the second paper (*ibid.*, No. 36) Dr. Pethybridge, in conjunction with Mr. P. A. Murphy, describes the results of investigations on the common potato blight fungus, *Phytophthora infestans*, and points out that much remains to be discovered regarding the life-history and modes of transmission of this well-known parasite. Thick-walled spores were found in the tissues of various parts of the potato plant that had been destroyed by *P. infestans*, and these are probably the oospores of this fungus. The two papers are illustrated by beautiful figures, including two plates of very fine photomicrographs.

In connection with the foregoing paragraphs, mention may be made of a paper received simultaneously, dealing with the same group of fungi, entitled "Studies in Peronosporaceæ," by Mr. E. J. Butler, Imperial Mycologist, and Mr. G. S. Kulkarni, Mycological Assistant, Bombay Department of Agriculture (Memoirs of the Department of Agriculture in India, Botanical Series, vol. v., No. 5, 1913). The forms described in detail by the authors are *P. colocasiae* (parasitic on *Colocasia esculenta*), the ubiquitous *Pythium debaryanum*, *Sclerospora graminicola* (parasitic on three Indian cereals and a fodder grass), and *S. maydis* (a very destructive parasite on maize, which has apparently reached India recently from Java). The four papers included in these careful studies are illustrated by fine plates, in some cases coloured, and directions are given for treatment of the disease in question. F. C.

EASTER VACATION WORK AT PORT ERIN.

THE Easter vacation party at the Port Erin Biological Station has this year been larger than ever before, and has carried out a longer programme of work—both in the laboratory and on the seashore. During the last few weeks (March and April) the number of researchers and senior students enrolled in the books of the station has reached the record total of eighty-five, including half a dozen professors and a dozen university lecturers and demonstrators, while nearly half of the total number were post-graduate researchers. Altogether twelve universities or university colleges have been represented. Practically all the senior students and post-graduate workers of the botanical and zoological departments of the University of Liverpool, under Profs. Harvey Gibson and Herdman, migrated to the Port Erin laboratory for the vacation. Prof. Cole brought a considerable contingent from the University College of Reading, and Dr. Stuart Thomson a number from Manchester; Mr. Holden came with some students from University College, Nottingham, and smaller groups came from Birmingham, Cambridge, Oxford, Bristol, Bangor, Cardiff, London, and Melbourne. In addition to the laboratory work of the students and their collecting expeditions on the seashore, the activities of the biological station at this time of year are threefold: first, the flat-fish hatching (seen at its best during March and April); secondly, the plankton investigation going on at sea from the s.y. *Runa*; and thirdly, the special investigations of the post-graduate researchers.

The spawning of the mature plaice in the open-air fish-ponds started at the beginning of February this year, at least a fortnight earlier than usual, and it is by no means finished yet. Already more than eight millions of eggs have been skimmed from the ponds, and about seven millions of young fish have been set free in the sea round the south end of the Isle of Man.

Work at sea was much hampered by bad weather during the earlier part of the time, and it was sometimes difficult to get the periodic plankton hauls taken. This is now the eighth year of Prof. Herdman's scheme of intensive study of the nature and distribution of the plankton, of which it is hoped to complete ten years' statistics before winding up the investigation. Up to the present the phytoplankton this spring has been characterised by the prevalence of Coscinodiscus.

In addition to the collecting and recording of rare species, both of animals and sea-weeds, which has gone on very much as in former years, there has been a large amount of special investigation both at sea and in the laboratory on the part of those who are engaged in the preparation of L.M.B.C. Memoirs, and also of others who are at various researches. For example, Mr. R. D. Laurie has been making observations on the movements of Amphidinium in the sand, Mr. S. T. Burfield has been working at Sagitta, Miss Gleave at Archidoris, Mr. H. G. Jackson on Decapod larvæ in the plankton, and Prof. B. Moore and Mr. E. Whitley on the nutrition of marine animals and the variations in the alkalinity of the sea-water. The memoir on Echinoderm larvæ which Mr. Chadwick has been engaged on for some years is now in the printer's hands, and will be published at an early date. The pressure on the laboratory accommodation has been very great during this vacation, and the need of further extension of the building is urgent.

W. A. H.

RELATIONS BETWEEN THE SPECTRA AND OTHER CHARACTERISTICS OF THE STARS. *

I.

Historical.

INVESTIGATIONS into the nature of the stars must necessarily be very largely based upon the average characteristics of groups of stars selected in various ways—as by brightness, proper motion, and the like. The publication within the last few years of a great wealth of accumulated observational material makes the compilation of such data an easy process; but some methods of grouping appear to bring out much more definite and interesting relations than others, and, of all the principles of division, that which separates the stars according to their spectral types has revealed the most remarkable differences, and those which most stimulate attempts at a theoretical explanation.

In the present discussion, I shall attempt to review very rapidly the principal results reached by other investigators, and shall then ask your indulgence for an account of certain researches in which I have been engaged during the past few years.

Thanks to the possibility of obtaining with the objective prism photographs of the spectra of hundreds of stars on a single plate, the number of stars the spectra of which have been observed and classified now exceeds one hundred thousand, and probably as many more are within the reach of existing instruments. The vast majority of these spectra show only dark lines, indicating that absorption in the outer and least dense layers of the stellar atmospheres is the main cause of their production. Even if we could not identify a single line as arising from some known constituent of these atmospheres, we could nevertheless draw from a study of the spectra, considered merely as line-patterns, a conclusion of fundamental importance.

The spectra of the stars show remarkably few radical differences in type. More than 99 per cent. of them fall into one or other of the six great groups which, during the classic work of the Harvard College Observatory, were recognised as of fundamental importance, and received as designations, by the process of "survival of the fittest," the rather arbitrary series of letters B, A, F, G, K, and M. That there should be so few types is noteworthy; but much more remarkable is the fact that they form a continuous series. Every degree of gradation, for example, between the typical spectra denoted by B and A may be found in different stars, and the same is true to the end of the series, a fact recognised in the familiar decimal classification, in which B5, for example, denotes a spectrum half-way between the typical examples of B and A. This series is not merely continuous; it is *linear.* There exist indeed slight differences between the spectra of different stars of the same spectral class, such as AO; but these relate to minor details, which usually require a trained eye for their detection, while the difference between successive classes, such as A and F, are conspicuous to the novice. Almost all the stars of the small outstanding minority fall into three other classes, denoted by the letters O, N, and R. Of these O undoubtedly precedes B at the head of the series, while R and N, which grade into one another, come probably at its other end, though in this case the transition stages, if they exist, are not yet clearly worked out.

From these facts it may be concluded that the prin-

* An address delivered before a joint meeting of the Astronomical and Astrophysical Society of America and Section A of the American Association for the Advancement of Science, at Atlanta, Georgia, December 30, 1913, with a few additions, by Prof. H. N. Russell.

cipal differences in stellar spectra, however they may originate, arise in the main from variations in a single physical condition in the stellar atmospheres. This follows at once from the linearity of the series. If the spectra depended, to a comparable degree, on two independently variable conditions, we should expect that we would be obliged to represent their relations, not by points on a line, but by points scattered over an area. The minor differences which are usually described as "peculiarities" may well represent the effects of other physical conditions than the controlling one.

The first great problem of stellar spectroscopy is the identification of this predominant cause of the spectral differences. The hypothesis which suggested itself immediately upon the first studies of stellar spectra was that the differences arose from variations in the chemical composition of the stars. Our knowledge of this composition is now very extensive. Almost every line in the spectra of all the principal classes can be produced in the laboratory, and the evidence so secured regarding the uniformity of nature is probably the most impressive in existence. The lines of certain elements are indeed characteristic of particular spectral classes; those of helium, for instance, appear only in Class B, and form its most distinctive characteristic. But negative conclusions are proverbially unsafe. The integrated spectrum of the sun shows no evidence whatever of helium, but in that of the chromosphere it is exceedingly conspicuous. Were it not for the fact that we are near this one star of Class G, and can study it in detail, we might have erroneously concluded that helium was confined to the "helium stars." There are other cogent arguments against this hypothesis. For example, the members of a star-cluster, which are all moving together, and presumably have a common origin, and even the physically connected components of many double stars, may have spectra of very different types, and it is very hard to see how, in such a case, all the helium and most of the hydrogen could have collected in one star, and practically all the metals in the other. A further argument—and to the speaker a very convincing one—is that it is almost unbelievable that differences of chemical composition should reduce to a function of a single variable, and give rise to the observed linear series of spectral types.

I need not detain you with the recital of the steps by which astrophysicists have become generally convinced that the main cause of the differences of the spectral classes is difference of temperature of the stellar atmospheres. There is time only to review some of the most important evidence which, converging from several quarters, affords apparently a secure basis for this belief.

The first argument is based upon the behaviour of the spectral lines themselves. To appreciate its full force, one must familiarise himself with a multitude of details. A typical instance is that of the heavy bands in the region of longer wave-length, which are the most characteristic feature of spectra of Class M, appear faintly in Class K5, and are absent in Class K and all those higher in the series. Fowler has shown[1] that these bands are perfectly reproduced in the spectrum of the outer flame of an electric arc charged with some compound of titanium, while the spectrum of the core of the arc, though showing conspicuously the bright lines of titanium, does not contain the bands. Here we are evidently dealing with some compound—perhaps titanium oxide—the vapour of which is present in the relatively cool flame of the arc, and emits a spectrum of the banded type, characteristic of compounds, while in the hotter core it is dissociated, and only the lines of the metal are seen. There seems then to be no escape from the conclusion that the atmospheres of stars of Class M are cool enough to permit the existence of this compound, and hence cooler than the core of the arc, and that the temperature of its dissociation is approached in Class K5, and surpassed in Class K. In general, those metallic lines which are relatively strong in the spectra produced in the oxyhydrogen flame or the electric furnace are also strong in spectra of Classes M and K; the lines most prominent in Class G are the typical arc lines; and the relatively few metallic lines which persist into Classes A and B are those which appear exclusively, or with greatly enhanced intensity, in the spark spectra of the laboratory.

[1] Proc. Roy. Soc., vol. lxxii., pp. 219–225, 1904.

The second line of evidence is afforded by the distribution of intensity in the continuous background of the spectra, the differences of which from type to type are obvious to the eye as differences in the colour of the stars. This characteristic is fortunately capable of accurate measurement. For the brighter stars, spectro-photometric comparisons may be made with a terrestrial light-source the energy curve of which is known, as has been done visually by Wilsing and Scheiner,[2] and photographically by Rosenberg.[3] Much fainter stars may be reached by the comparison of their brightness as measured visually (or on isochromatic plates with a suitable colour-screen), and photographically on ordinary plates. The "colour-index" so obtained, which expresses, in stellar magnitudes, the relative photographic brightness of stars of equal visual brightness, is found to be very intimately related to the spectral type, the differences within each spectral class being scarcely greater than the errors of observation. The results of King,[4] Parkhurst,[5] and Schwarzschild,[6] working with different instruments and on stars of very different brightness, are in excellent agreement, as is shown in Table I. The near approach to equality among the differences in colour-index from class to class is very remarkable, when it is considered that these types were picked out somewhat arbitrarily according to the general appearance of the photographic spectra. The judgment of the Harvard observers in selecting the really important points of difference was evidently very good.

Table I.

Spectrum	Colour-index King	Colour-index Parkhurst	Colour-index Schwarzschild	Temperature °
B0	−0·32			20,000
B5	−0·17	−0·21	−0·20	14,000
A0	0·00	0·00	0·00	11,000
A5	0·19	0·23	0·20	9,000
F0	0·30	0·43	0·40	7,500
F5	0·42	0·65	0·60	6,000
G0	0·72	0·86	0·84	5,000
G5	0·98	1·07	1·10	4,500
K0	1·10	1·30	1·35	4,200
K5	1·62	1·51	1·80	3,200
M	1·62	1·68		3,100
N		2·5		2,300

If the spectral sensitiveness of the plates used in such investigations has been determined (as Parkhurst has done) it is possible to calculate the temperature at which a black-body would emit light of the same colour as that observed; and similar calculations can be made, with greater accuracy, from the spectrophotometric data. The last column of Table I. gives the effective temperatures thus derived (based mainly on the work of Wilsing and Scheiner). The absolute

[2] Potsdam Publications, vol. xix., part 1.
[3] *A.N.*, 4628, 1913.
[4] Harvard Annals, vol. lix., p. 179.
[5] *Astrophys. Jour.*, vol. xxxvi., p. 218, 1912.
[6] Göttingen Aktinometrie, Teil B, p. 19.

values of the temperatures here given may be considerably in error, especially at the top of the scale (in fact, Rosenberg's work indicates a much greater range), but there can be no doubt about the relative order.

Of a third independent confirmation of the temperature hypothesis, based on the determination of the surface brightness of the stars, I shall have occasion to speak later.

It should be expressly stated that the "temperatures" here spoken of are the effective "black-body" temperatures corresponding to the spectral distribution of the radiation. Unless the surfaces of the stars possess decided selective emissivity for certain wavelengths, these effective temperatures should also indicate with tolerable accuracy the energy-density of the flux of radiation which escapes from them. This tells us little about the temperature of the deeper regions; but it must be the main, if not the only, factor in determining the temperature of those outer and nearly transparent layers of the atmospheres in which the characteristic line absorption takes place. If we further assume, in accordance with Abbot's studies of the solar atmosphere,[7] that the absorption is nearly complete in so small a thickness of the atmosphere that wide variations in its depth and density would modify its total absorption but little, it becomes easy to see how the influence of its temperature (which presumably determines the relative strength of absorption in different lines) may predominate so greatly over all that of all other factors in determining the spectral type.

We may now review rapidly some of the relations which have been brought to light between other characteristics of the stars and their spectral types. First, as regards the relative numbers of stars of the different classes, we have in Table II. some results of counts made at Harvard.[8]

TABLE II.

Spectrum	O	B	A	F	G	K	M	N
No. above 3·25m.	3	52	32	16	20	35	21	0
,, 6·25m.	20	696	1885	720	609	1719	457	8
Percentage in Galactic region	100	82	66	57	58	56	54	87

Classes A and K make up more than half of all the stars brighter than 6·25 m—that is, of the stars visible to the naked eye. The remaining stars are divided fairly evenly among the other four principal classes, while only one star in 300 is of Class O, and only one in 800 of Class N. The relative proportions of the different classes are, however, different in different parts of the heavens, as is indicated by the last line of the table, which give the percentage of stars of each class which lie in a belt covering one-half of the celestial sphere, and extending for 30° each side of the Milky Way. All the stars of Class O are close to the central line of the Galaxy (except for a few in the Magellanic Clouds). The stars of Class B are very strongly concentrated in the galactic region; those of Class A are considerably so; those of the following classes very little, except in the case of Class N (for which the tabular percentage is derived, not from the eight brightest stars of this class alone, but from a much larger number of fainter ones).[9]

The relative proportions of the different classes vary also with the apparent brightness of the stars. Among the stars brighter than 3·25m., as the table shows, Class B has more representatives than any other; but the percentage of this type steadily diminishes as we pass to fainter stars. The percentage of stars of Class A at first increases with diminishing visual brightness; but there is good reason to believe that, at least in regions remote from the Galaxy, the relative proportion of these too falls off rapidly in the neighbourhood of the ninth magnitude[10]; and Fath's work on the integrated spectrum of the Milky Way[11] shows that, even there, the bulk of the very faint stars which form the galactic clouds must be of Secchi's second type (F, G, or K).

Counts of the stars down to any given magnitude may, however, be very misleading unless we bear in mind the enormous preference which this method of observation gives to the stars of great actual luminosity, which can be seen afar off, and hence are being sought in a much greater volume of space than those of small luminosity. A difference of but five magnitudes in the real brightness of two groups of stars gives the brighter kind (if both are uniformly distributed in space) a thousand-fold better chance of getting into our catalogues; and this example understates the actual conditions in some cases. Mere counts of stars need therefore to be supplemented by such knowledge as we can obtain concerning their distances.

Much information can be obtained from the average proper-motions of the stars of the various classes, and still more by deriving their average parallaxes from the mean parallactic drift due to the motion of the solar system in space. Studies of this character have been made by several investigators of the first rank. Their results, which are summarised in Table III., show certain apparent discrepancies, which, however, arise principally from differences in the methods according to which the various workers have selected the groups of stars for investigation.

TABLE III.

Spectrum	Mean centennial proper-motion			Mean parallax			
	Kapteyn	Boss	% rejected	Kapteyn	Boss	Campbell	% rej.
	"	"		"	"	"	
O		1·6	0		0·004		
B	2·6	2·4	0	0·007	0·007	0·006	0
A	5·8	4·6	3	0·010	0·010	0·016	3
F	14·5	7·7	28	}	0·012	0·035	3
G	27·0	5·2	20	} 0·022	0·008	0·022	8
K	13·0	5·7	6	}	0·010	0·015	9
M	5·9	5·0	6	0·011	0·008	0·011	3
N		3·2		0·0007			

Kapteyn's data[12] represent the mean proper motions and parallaxes of all the stars of the fifth magnitude of each class, except for Class N, in which, to get enough stars, it was necessary to include faint objects, so that the average magnitude is here 8·3. His results show a conspicuous maximum of average proper-motion and parallax for Class G, with a rapid fall on both sides of it. The stars of Class N would have to be brought about five times nearer to appear as bright as the others, but even then they would have the smallest mean parallax of all.

Boss,[13] in his investigation of the solar motion, had at his disposal very accurate proper-motions of all the stars down to 5·7m., and about half as many more between this and the seventh magnitude. The average magnitude of his stars is therefore nearly the same as that of Kapteyn's. But, for very good reasons, he excluded from his main solution all stars with proper-motions exceeding 20″ per century. The percentage of stars thus excluded (which differs greatly from class to class) is given in the fourth column of Table III. It is natural that this often drastic rejection of the large proper-motions, and hence in general

[7] Abbot, "The Sun," p. 252, 1911.
[8] Harvard Annals, vol. lxiv., p. 134.
[9] Harvard Annals, vol. lxvi., p. 213.

[10] *Astronomical Journal*, vol. xxvi., p. 153, 1910.
[11] *Astrophys. Journal*, vol. xxxvi., pp. 362–367, 1912.
[12] *Astrophys. Journal*, vol. xxx., p. 295 : vol. xxxii., p. 91, 1909–10.
[13] *Astronomical Journal*, vol. xxvi., pp. 187–201, 1911. The mean proper-motions of the few stars of Classes O and N which appear in Boss's Catalogue have been added by the writer.

of the nearer stars, should greatly diminish his mean values. Among the classes in which the mean proper-motion is small, the percentage of exclusion is also small, and the results are but little modified. But it is noteworthy that the exclusion of 6 per cent. of the stars of Class K has reduced the mean proper-motion in a greater ratio than that of 28 per cent. of those of Class F, and also that the removal of one-fifth of the stars of Class G decreases the mean for the remainder to less than one-fifth of its initial value. It appears from these results that a large majority of the stars of Classes F, G, and K have nearly, if not quite, as small parallaxes and proper-motions as those of Classes A and M, though they are not quite so remote as the stars of Class B. The large mean values obtained for all the stars of these classes are due to the presence of a relatively small proportion of near and apparently rapidly moving stars, of which the percentage decreases, but the mean proper-motion and parallax increase, from F to K.

Campbell's results [14] are derived from a comparison of the radial velocities and proper-motions of nearly 1200 stars, mostly brighter than the fifth magnitude, and averaging about a magnitude brighter than Boss's stars, which would lead us to expect that their mean parallaxes should be 40 or 50 per cent. greater. In his work, "a few stars having proper-motions abnormally large for their classes were omitted in accordance with definitely set limits" (which unfortunately are not described more specifically). The approximate percentage of exclusion is given in the last column of the table. It appears on inspection that the differences between Campbell's and Boss's results for stars of Classes A, K, and M arise mainly from the greater brightness of Campbell's stars; those for Classes F and G are due mainly to the different percentages of exclusion, and that the only significant difference is that Campbell's B stars, though averaging much brighter to the eye than Boss's, have a slightly smaller mean parallax, and therefore must be, on the average, of greater real brightness.

Closely allied with these investigations is the determination of the mean peculiar velocity of the stars of each spectral class. The results of Boss and Campbell, reached almost simultaneously, and from quite independent data—proper-motions in one case and radial velocities in the other—are in extraordinary agreement. The values found for the average component of motion in any arbitrary direction are (in kilometres per second):—

Spectrum	B	A	F	G	K	M
Campbell	6·5	10·5	14·4	15·9	16·8	17·1
Boss	6·3	10·2	16·2	18·6	15·1	17·1

The rapid increase of the mean velocity from B to F is very remarkable. The slow further gain from F to M would attract little attention if it were not in the same direction.

It should here be added that the phenomenon known as preferential motion, or "star-streaming"—the excess of the average peculiar velocity of the stars in a certain direction above those in the perpendicular directions—is almost absent in Class B, very conspicuous in Class A, and somewhat less so in the following classes, being partially concealed by the greater average magnitude of the velocities.

Another notable difference between the various spectral classes may be found in the number of binary stars, both visual and spectroscopic, among them. We may distinguish two classes of visual double stars; binary stars for which orbits have been computed (with periods rarely exceeding two centuries), and physical pairs, the real connection of which is proved by common proper-motion, but the relative motions of which are slow, and periods long—probably often thousands of years. The counts of the two classes here given are from a list prepared in the course of my work, and include all stars for which the necessary data could be obtained, including many stars for which unpublished observations of spectra have been generously furnished me from Harvard. For the spectroscopic binaries, Campbell's counts have been taken from his catalogue of 1910.[15] They include all the systems the periods of which were then known, and are divided into two groups, one including all the periods of which are less than ten days, and also all those the periods of which, though not exactly known, are described as short; the other all the known periods exceeding ten days, and those which, though not precisely determined, are known to be long.

TABLE IV.

Spectrum	Visual binaries	Physical pairs	Spectroscopic binaries Short period	Spectroscopic binaries Long period
B	0	52	33	15
A	14	152	15	14
F	33	115	11	9
G	24	74	8	14
K	12	62	0	13
M	0	11	0	2

It appears that, in Campbell's picturesque phrase, visual double stars of relatively short period "abhor" Classes B and M, the greatest number being of Class F, with G a good second. Among the physical pairs, of long period, the most favoured class is A. Class B is abundantly represented, and Class M very sparingly.

The percentage of stars which are found to be spectroscopic binaries is very probably greater among Classes B and A than lower down the list. As time goes on, indeed, more and more of the stars of these "later" types are found to be spectroscopically double, but of long period; but among these classes the detection of such systems, where the range of velocity is small, is much easier than among the stars of the first type, the lines of which are diffuse. In any case it is certain that short periods are almost confined to Classes B, A, and F, and are especially abundant in the first of these. The few short-period stars of Class G which appear in the table are all Cepheid variables, most of which were selected for observation on this account, and would not otherwise have got into the list.

Finally, we may note that, among variable stars, those of the eclipsing type, such as Algol or Beta Lyræ, are for the most part of Classes A and B, though there are a number of Classes F and G, and one at least of Class K; that the Cepheid variables are almost all of classes F and G, with a few A's and K's; and that almost all the irregular variables, and all the variables of long period, are of Classes M or N. Stars of Class M the spectra of which show bright hydrogen lines are without exception variable, and almost all the stars of Class N are also subject to changes in brightness.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. James Ward, professor of mental philosophy and logic, has been nominated to represent the University on the occasion of the celebration at Oxford on June 10 of the seventh centenary of the birth of Roger Bacon, and Dr. Sorley, Knightbridge professor of moral philosophy, to represent the Univer-

[14] Lick Observatory Bulletin, vol. vi., p. 134, 1911.

[15] Lick Observatory Bulletin, vol. vi., p. 38, 1910.

sity at the fifth International Congress of Philosophy to be held in London next year.

EDINBURGH.—It is announced that the honorary degree of LL.D. is to be conferred on Dr. F. W. Mott, F.R.S., and Dr. Byrom Bramwell on July 3.

OXFORD.—The Romanes Lecture for this year will be delivered in the Sheldonian Theatre on Wednesday, June 10, by Sir J. J. Thomson, upon the subject of "The Atomic Theory."

MR. J. D. ROCKEFELLER has given the sum of 200,000*l.* to the Rockefeller Institute for Medical Research, New York, as an endowment for a new department which is to deal with the diseases of animals.

THE following Chadwick lectures have been arranged for London:—Thursday, April 30, "Water Supply: Sources, Reservoirs, and Distribution," E. P. Hill; Wednesdays, May 6, 13, and 20, a course of three lectures, "Altitude and Health," Prof. F. F. Roget, of the University of Geneva; Wednesday, May 27, "Milk Supply: a Public Health Criticism," Prof H. R. Kenwood. Admission to all or any of the lectures is free. Information concerning future Chadwick Lectures may be obtained of the secretary, Mrs. Aubrey Richardson, at the offices of the trust, 8 Dartmouth Street, Westminster.

A UNIVERSITY College of Science is shortly to be started in Calcutta as the result of generous gifts by Sir T. Palit and Dr. Rashbehary Ghose. The services of Dr. P. C. Rây, professor of chemistry in the Presidency College, Calcutta, will be lent by Government to the college, and as such he will be made the Palit professor of chemistry in the University of Calcutta. In a note on this appoinment in NATURE of March 19 (p. 75) it was incorrectly stated that Dr. Rây had been appointed to the Palit professorship in the Presidency College, whereas, as is well known, he has been professor of chemistry in that college for many years. We learn from the *Pioneer Mail* of April 3 that the foundation stone of the new college in connection with the Calcutta University was laid on March 27 last by Sir Asutosh Mookerjee, Vice-Chancellor of the University. In performing the ceremony, Sir Asutosh said that the scheme was first rendered practicable by the execution of a trust deed by Sir Taraknath Palit, by which he transferred money and land for the promotion of pure and applied science among his countrymen. A few weeks later Sir Taraknath executed a second deed for the purpose of supplementing the trusts mentioned in the first deed. The University Syndicate had received Government's permission to apply 800*l.* annually for the maintenance of the laboratory, and Dr. Rashbehary Ghose has offered 67,000*l.* for the foundation of four professorships and eight research studentships.

THE Department of Agriculture and Technical Instruction for Ireland will, in July, 1914, award a limited number of commercial scholarships (not more than six) to young men who have had a sound general education and some commercial experience. The object of the scholarships is to afford facilities for the holders to obtain training in some higher institution, approved by the Department, with a view to their employment as teachers of commercial subjects in Ireland. The scholarships are of the value of 100*l.* per annum each, and are tenable for two years. Candidates must be at least twenty-one years of age on July 1, 1914, and must have been born in Ireland, or have been resident in Ireland for three years immediately preceding July 1, 1914. Successful candidates will be required to enter into an undertaking that they will engage in the teaching of commercial subjects after the termination of their scholarships. Candidates must fill in Form S. 195 and return it to the secretary of the Department not later than May 30, 1914. Copies of this form may be had on application.

THE Standing Committee of the House of Commons has now concluded its consideration of Mr. Denman's Children (Employment and School Attendance) Bill, and the Bill will be reported to the House for third reading. Several important changes have been made, and new clauses added. As amended, the Bill proposes the following changes in the existing law:—Limitation of powers of local education authorities: (1) No exemption from school attendance allowed for children under thirteen years of age; (2) restrictions in exemption above thirteen. Extension of powers of local education authorities: (1) Optional powers granted to extend school leaving age to fifteen; (2) optional powers granted to make employment by-laws for children up to age of sixteen (instead of fourteen as at present). Abolition of existing half-time system and a restriction on street trading. The Bill renews proposals passed by Standing Committees of the House of Commons in 1912 in the Education (School Attendance) and the Employment of Children Bills. The chief objects of the Bill not contained in those Bills are the transference of the duty of approving by-laws relating to the employment of children from the Home Office to the Board of Education, and the raising to fifteen of the school leaving age and the minimum age for boys engaged in street trading.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 27.—Sir J. J. Thomson, president, in the chair.—F. W. **Jordan**: A new type of thermogalvanometer. The puff of air from an orifice in an air chamber when the air within is heated suddenly is utilised to deflect a small suspended vane. The current to be measured is made or broken through a heater of small thermal capacity in the air chamber and the outrush or inrush of air through the orifice delivers an impulse to the vane. In one instrument the sensibility was 4 mm. per microwatt, and the extremity of the throw of the vane was attained in two seconds.—J. D. **Morgan**: An instrument for recording pressure variations due to explosions in tubes. A mechanical oscillograph for recording the pressure variations which accompany a gas explosion in an open tube. A steel vane of rectangular form is employed and is mounted parallel to the explosion tube in a cell presenting a lateral opening to the interior. Along three edges the vane is free, and along the fourth is attached to a torsion wire. The vane fits the cell as closely as possible without touching the sides of the cell. The diagram is produced by a style on smoked paper wrapped round a clock-driven drum, and on the strip is described a time curve. To make the instrument dead-beat a dash-pot is mounted on the front of the vane cell and attached to the style.—R. **Appleyard**: The direct measurement of the Napierian base. A simple apparatus was described intended to convey an idea of the way in which the base e of the Napierian logarithms enters into physical problems. A length of chain hung from a loop of thread, and the remaining part of the chain pulled aside until the thread is at 45° to the vertical. The curved portion becomes a true catenary when the angle between the vertical and curved portions of chain at the attachment of the loop is 90°. To ensure this, the circle of curvature of the catenary at that point is drawn, and found to have a radius equal to the vertical portion. If the vertical length is taken as unity, and its lower end as origin, it is shown that e is the sum of the y-ordinate at $x=1$, and the length of the curved chain between the point where that y-ordinate cuts the curve and the top of the vertical portion. The application of this result to the relationship and meaning of hyperbolic functions was also shown.

Zoological Society, April 7.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. Two new species of tapeworms belonging to the genera Linstowia and Oochoristica were described.—E. W. **Shann**: The lateral muscle of Teleostei. The author has undertaken the present work in view of the conflicting statements extant as to the nature of the lateral muscle in Teleostean fishes; the primary object of the paper is to uphold the single-layer theory of its composition.—Dr. W. T. **Calman**: Report on the river-crabs (Potamonidæ) collected by the British Ornithologists' Union and Wollaston Expeditions in Dutch New Guinea. Two new species were described.—Oldfield **Thomas**: Report on the mammals collected by the British Ornithologists' Union and Wollaston Expeditions in Dutch New Guinea. The species obtained numbered thirty-one, of which the types of twelve had been brought home by the expeditions. The two expeditions had obtained a very valuable series of ground-animals, notably of the genus Uromys, but there seemed to be, in the part of New Guinea explored, a remarkable absence of arboreal species, these forming in other parts of New Guinea a large proportion of the mammal fauna.—Guy **Dollman**: Mammals obtained by Mr. Willoughby P. Lowe during the recent East African Expedition organised by Mr. G. P. Cosens. The entire collection, some two hundred specimens in all, was presented by Mr. Cosens to the national collection. Besides examples of many rare and important species, specimens of several new forms were included.

Geological Society, April 8.—Dr. A. Smith Woodward, president, in the chair.—Prof. J. W. **Gregory**: The evolution of the Essex river-system, and its relation to that of the Midlands. The post-Eocene geology of Essex must be learnt from its gravels and their non-local constituents. In the absence of any rock which affords a certain proof of its route, the effort was made to determine the direction of transport by tracing the variations in the proportions and size of the non-local constituents; this test shows that the quartzites and felsites came from the north-west, and the Lower Greensand cherts from the south and south-east. The gravels are classified as follows:—(1) The oldest series. The Brentwood group, which consists of redeposited Bagshot Beds and of local materials only. (2) The Danbury Gravel, which was deposited before the arrival of the felsites, and at the beginning of the arrival of the Lower Greensand cherts. (3) The Braintree Gravel, which is largely composed of quartzitic drift, with abundant Lower Greensand cherts and some felsites that were probably derived from the Lower Greensand conglomerates north-west of Essex. (4) and (5) Glacial and post-Glacial gravels. Judged from the distribution and dates of appearance of the non-local constituents in these gravels, the evolution of the Essex river-systems is traced. The Lower Thames and Essex river-systems appear to be due to the Eocene earth-movements which formed the London Basin; and the coeval uplift of the English Midlands started thence a radial drainage. The streams to the south-east cut the wind-gaps on the Chiltern Hills, and the drainage to the south-west flowed along a subsidence on the north-western side of the Jurassic escarpment as the Warwickshire Avon and the Lower Severn.—J. B. **Scrivenor**: The topaz-bearing rocks of Gunong Bakau (Federated Malay States). Gunong Bakau is a peak, 4426 ft. high, in the main range of the Malay Peninsula. It is composed of porphyritic granite, into which have been intruded veins of quartz-topaz rock, and, at a later date, masses and veins of topaz-aplite.

Royal Meteorological Society, April 22.—J. E. **Clark** and R. H. **Hooker**: Report on the phenological observations from December, 1912, to November, 1913. This dealt with the dates of the flowering of plants, the song and migration of birds, the appearance of insects, and also the character of farm crops. Considering England as a whole, the main feature of the weather, so far as it affected crops, was the cold wet summer of 1912, the abundant precipitation during the spring, which resulted in a bountiful hay crop, and the dry summer.—A. J. **Bamford**: A small anemometer for tropical use.

Mathematical Society, April 23.—Prof. A. E. H. Love, president, in the chair.—Major P. A. **MacMahon**: (1) A modified form of pure reciprocants possessing the property that the algebraical sum of the coefficients is zero. (2) Lattice and prime-lattice permutations.

Dublin.

Royal Dublin Society, April 21.—Dr. J. H. Pollok in the chair.—Prof. W. **Brown**: Note on the change of length in nickel wire due to small longitudinal loads and low alternating magnetic fields. It is shown in this note that the contraction of the nickel wire is from 63 to 44 per cent. greater than for equivalent direct continuous magnetic fields. The loads employed were from $0{\cdot}1184 \times 10^5$ to 10^5 grams per sq. cm., and magnetic fields up to 200 c.g.s. units.

Paris.

Academy of Sciences, April 20.—M. P. Appell in the chair.—Maurice **Hamy** and M. **Millochau**: The effects of variations of voltage on the intensity of the radiations of the arc obtained with an arrangement utilising an alternating current. The time of exposure of a photographic plate for a constant impression was found to be proportional to V^{-9}, where V is the voltage.—A. **Haller** and Edouard **Bauer**: The action of sodium amide on the allyldialkylacetophenones. General method of synthesis of the trialkylpyrrolidones. This ketone does not follow the normal reaction, production of benzene and trialkylacetic acid, but forms a condensation product, $C_7H_{13}ON$. The reactions of this substance were in agreement with those of a 3:3:5-trimethylpyrrolidone, and this constitution was confirmed synthetically.—Charles **Moureu** and Jacques Ch. **Bongrand**: Carbon subnitride. The action of ammonia and amines. The nitride, $CN-C\equiv C-CN$, enters violently into combination with ammonia and amines. Ammonia gives aminobutenedinitrile, $CN.C(NH_2)=CH.CN$, and homologues of this are produced when amines are substituted for ammonia.—M. **Considère**: The contraction of armoured concrete: its influence on the forces developed in armoured concrete constructions. A comparison of experimental results obtained by Otto Graf at Stuttgart with some made at the laboratory of the Ecole des Ponts et Chaussées at Paris, and a discussion of a recent note by M. Rabut on the same subject.—O. **Lehmann**: The suction effects observed in liquid crystals in the course of growth (myelinic forms).—J. A. F. **Balland**: The lowering of the proportion of gluten in flour. The bread-making properties of Parisian flour have deteriorated during recent years, and this is in part due to the decline in the proportion of gluten in the flour. The causes of this decline are discussed.—P. **Chofardet**: Elements and ephemerides of the Kritzinger comet, 1914*a*.—M. **Gunther**: The general theory of systems of partial differential equations.—Marcel **Moulin**: Influence of the rachet on the concentric development of the spiral springs of chronometers.—Jean **Bielecki** and Victor **Henri**: The calculation of the absorption spectrum of a body from its chemical composition. A general formula is given for the absorption spectrum of a substance containing two chromophores.—F. **Dienert**: A new nephelometer for use in analytical chemistry.—E. **Cornec** and G. **Urbain**: The application of cryoscopy to the determination of double salts in aqueous solution. A study of the double salts of cadmium chloride, bromide, and iodide with the alkaline haloid salts.—F. **Pisani**: Some calcites showing marked phosphorescence under the action of heat.—N. **Bezssonoff**: Some facts relating to the formation of the perithecium and the delimitation of the ascospores in the Erysiphaceæ.—J. **Wolff**: The mechanism of oxidation and reduction phenomena in plant tissues. A study of the oxidation and reduction phenomena produced by the oxydase present in the apple and pear.—F. Le **Cerf**: A grub of the family Lycænidæ raised in Acacia galls by ants of the genus Cremastogaster. The grub is fed inside the gall with acacia leaves provided by the ants.—L. **Joleaud**: The eastern termination of the Numidian chain (Algeria).—Robert **César-Franck**: The relations between the form of the southern coast line of England and its geological constitution.

Calcutta.

Asiatic Society of Bengal, April 1.—A. **d'Orchymont**: Hydrophilidæ from the Lake of Tiberias. The hydrophilid beetles are represented in Dr. Annandale's collection by sixteen specimens, including examples of six species.—M. S. **Ramaswami**: Note on leaf-variation in *Heptapleurum venulosum*, Seem. This paper illustrates the remarkably wide range of leaf-variability in the above species. The author shows that the method used in "The Flora of British India" for differentiating between the two sections of the subgenus Euheptapleurum, namely, the simply digitate or twice digitate character of the leaves, is incorrect so far as this species is concerned.—Dr. W. M. **Tattersall**: Amphipoda and Isopoda from the Lake of Tiberias. Three species of Amphipoda and three of Isopoda are included in Dr. Annandale's collection. It seems probable, on comparing these with the collections made by Barrois and by Festa, that the complete fauna of the Lake of Tiberias is now known, so far as the aquatic and semi-aquatic representatives of the two groups are concerned. Of the species in the collection, one Amphipod, *G. syriacus*, and one Isopod, *A. soxalis*, are endemic and have not so far been found outside Syria. The remaining species are distinctly "Mediterranean" in character, though one (*Orchestea platensis*) is known also from the Atlantic coasts of America.

BOOKS RECEIVED.

Reports upon the Present Condition and Future Needs of the Science of Anthropology. Presented by W. H. R. Rivers, A. E. Jenks, and S. G. Morley. Pp. 91+14 plates. (Washington: Carnegie Institution.)

Department of Marine Biology of the Carnegie Institution of Washington. Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. v. Pp. 222. (Washington: Carnegie Institution.)

King Edward VII. Sanatorium, Midhurst. Preliminary Report on the Treatment of Pulmonary Tuberculosis with Tuberculin. By Dr. N. D. Bardswell. Pp. xxi+141. (London: H. K. Lewis.) 6*s*. net.

Instituto Central Meteorológico y Geofisico de Chile. No. 4, Observaciones Meteor. en la Isla de Pascua. Mayo 1911–Abril 1912. Pp. viii+180+charts. (Santiago de Chile.)

A Text-Book of Geology. By Prof. J. Park. Pp. xv+598+70 plates. (London: C. Griffin and Co., Ltd.) 15*s*. net.

The Railways of the World. By E. Protheroe. Pp. xx+752+plates xvi. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

Handbook and Guide to the British Birds on Exhibition in the Lord Derby Natural History Museum, Liverpool. Pp. ix+69+plates 12. (Liverpool: C. Tinling and Co., Ltd.) 6*d*.

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e. Partie. Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Régions des Alpes et du Sud-Ouest). Etudes Glaciologiques Savoie-Pyrénées. Tome iii. Pp. viii+166+plates xix. (Région des Alpes) Annexe du Tome v. Cartes. (No publisher's name given.)

Geschichte der Chemie von den Altesten Zeiten bis zur Gegenwart. By Prof E. von Meyer. Vierte Auflage. Pp. xiv+616. (Leipzig: Veit and Co.) 13 marks.

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1907–08 to 1911–12. Vol. ii. Pp. ii+123. (Calcutta: Superintendent Government Printing, India.) 1*s*. 6*d*.

The Antiquity of Man in Europe, being the Munro Lectures, 1913. By Prof. J. Geikie. Pp. xx+328+xxi plates and maps. (Edinburgh: Oliver and Boyd.) 10*s*. 6*d*. net.

Biology, General and Medical. By Prof. J. McFarland. Second edition. Pp. 457+3 plates. (Philadelphia and London: W. B. Saunders Co.) 7*s*. 6*d*. net.

The Bacteriological Examination of Food and Water. By Dr. W. G. Savage. Pp. x+173. (Cambridge University Press.) 7*s*. 6*d*. net.

Isolation Hospitals. By Dr. H. F. Parsons. Pp. xiv+275. (Cambridge University Press.) 12*s*. 6*d*. net.

Country House Electric Lighting. Pp. 50 (South Kensington: Rawlings Bros., Ltd.)

Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1913. Pp. iv+239. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s*. 4*d*.

Some Desert Flowers Collected near Cairo. By G. M. Crowfoot. Pp. 50. (Cairo: F. Diemer.)

Behavior Monographs. Vol. ii., No. 4. Habit Formation in a Strain of Albino Rats of less than Normal Brain Weight. By G. C. Basset. Pp. iv+46. (Cambridge, Mass.: H. Holt and Co.)

Ueber den Mechanismus der Oxydationsvorgänge im Tierorganismus. By Dr. L. Stern. Pp. vi+61. (Jena: G. Fischer.) 2.20 marks.

Grundlehren der Chemie und Wege zur künstlichen Herstellung von Naturstoffen. By Dr. E. Rüst. Pp. iv+138. (Leipzig and Berlin: B. T. Teubner.) 1.60 marks.

Ueber den dermaligen Stand des Krallismus. By Prof. H. Dexler. Pp. 49. (Prag: D. Kuh.)

Conférences de Radium-biologie. Faites à l'Université de Gand en 1913. Pp. 214. (Bruxelles: L. Severyns.) 6 francs.

Answers to the Exercises in a School Course in Geometry. By W. J. Dobbs. Pp. 16. (London: Longmans and Co.) 6*d*. net.

The Riddle of Mars the Planet. By C. E. Housden. Pp. xi+69+plates. (London: Longmans and Co.) 3*s.* 6*d.* net.

The Religion of a Naturalist. By H. A. Longman. Pp. viii+123. (London: Watts and Co.) 1*s.* net.

Annuaire de l'Académie Royale des Sciences, etc., de Belgique. Quatre-Vingtième Année. Pp. 594+plates. (Bruxelles: Hayez.)

Bell's Outdoor and Indoor Experimental Arithmetics. By H. H. Goodacre, E. F. Holmes, C. F. Noble, and P. Steer. Teacher's Book. Pp. xii+377. (London: G. Bell and Sons, Ltd.) 3*s.* 6*d.* net.

The Progress of Eugenics. By Dr. C. W. Saleeby. Pp. x+259. (London: Cassell and Co., Ltd.) 5*s.* net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–13. By R. M. Milne. (London: Macmillan and Co., Ltd.) 6*s.*

Iowa Geological Survey. Bulletin No. 4. The Weed Flora of Iowa. By L. H. Pammel and others. Pp. xiii+912. (Des Moines: Iowa Geological Survey.)

Baumé and Specific Gravity Tables for Liquids Lighter than Water. By N. H. Freeman. Pp. 27. (London: E. and F. N. Son, Ltd.) 2*s.* 6*d.* net.

An Elementary Treatise on the Calculus for Engineering Students. By J. Graham. Fourth edition. Pp. 355. (London: E. and F. N. Spon, Ltd.) 5*s.* net.

Flower Favourites: their Legends, Symbolism, and Significance. By L. Deas. Second edition. Pp. viii+229. (London: Jarrold and Sons.) 3*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 30.

ROYAL SOCIETY, at 4.30.—The Presence of Inorganic Iron Compounds in the Chloroplasts of the Green Cells of Plants, considered in Relationship to Natural Photo-synthesis and the Origin of Life: Prof. B. Moore.—The lack of Adaptation in the Tristichaceæ and Podostemaceæ: Dr J. C. Willis.—The Genetics of Tetraploid Plants in *Primula sinensis*: R. P. Gregory.—The Action of certain Drugs on the isolated Human Uterus: J. A. Gunn.—The Influence of Osmotic Pressure upon the Regeneration of *Gunda ulvae*: D. J. Lloyd.—(1) *Glossina brevipalpis* as a Carrier of Trypanosome Disease in Nyasaland. (2) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma pecorum.* III. Development in *Glossina morsitans*: Surg.-Gen. Sir D. Bruce, Major A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.

ROYAL INSTITUTION, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R. Inge.

FRIDAY, MAY 1.

ROYAL INSTITUTION, at 9.—A Criticism on Critics: E. F. Benson.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Control and Organisation of the Engineering Profession: S. T. Robson.

GEOLOGISTS' ASSOCIATION, at 8.—A Geological Excursion in Matabeleland: F. P. Mennell.

SATURDAY, MAY 2.

ROYAL INSTITUTION, at 3.—Similarity of Motion in Fluids. (2) The General Law of Surface Friction in Fluid Motion: Dr. T. E. Stanton.

BRITISH PSYCHOLOGICAL SOCIETY.—The Psychology of Play with Special Reference to the Value of Group Games in Education: Miss M. J. Reaney.—Corresponding points: Prof. C. Spearman.—An Attempt at an Exact Estimation of Character: E. Webb.

MONDAY, MAY 4.

VICTORIA INSTITUTE, at 4.30.—Frederic Godet, Tutor of Frederick the Noble: Prof. F. F. Roget.

SOCIETY OF ENGINEERS, at 7.30.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Apparatus for the Automatic Measuring and Injection of Chemicals: Hon. R. C. Parsons.—Jets for Mixing: Dr. Oscar Nagel.—A Reaction of Tetranitromethane: W. R. Hodgkinson.

ARISTOTELIAN SOCIETY, at 8.—The Psychology of Dissociated Personality: Dr. W. Leslie Mackenzie.

ROYAL SOCIETY OF ARTS, at 8.—Some Recent Developments in the Ceramic Industry: W. Burton.

TUESDAY, MAY 5.

ROYAL INSTITUTION, at 3.—Double Flowers: Prof. W. Bateson.

ZOOLOGICAL SOCIETY, at 8.30.

RÖNTGEN SOCIETY, at 8.15.—X-rays and Crystals: L. W. Bragg.

INSTITUTION OF CIVIL ENGINEERS at 9.—Twenty-second "James Forrest" Lecture: The Flying Machine from an Engineering Standpoint: F. W. Lanchester.

WEDNESDAY, MAY 6.

ROYAL SOCIETY OF ARTS, at 8.—Inexpensive Motoring: A. L. Clayden.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Detection of Castor Oil Seeds: Dr. G. D. Lander and J. J. Geake.—The Composition of Milk: H. D. Richmond.—Note on "Sharps": J. F. Liverseege and G. D. Elsdon.

AERONAUTICAL SOCIETY, at 8.30.—The Calculation of Aeroplane Wing-Spar Stresses: H. Booth.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MAY 7.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: (1) Some Calculations in Illustration of Fourier's Theorem; (2) The Theory of Long Waves and Bores: Lord Rayleigh.—Protection from Lightning and the Range of Protection afforded by Lightning Rods: Sir J. Larmor and J. S. B. Larmor.—The Flow in Metals subjected to Large Constant Stresses: E. N. da C. Andrade.—The Properties of Magnetically-shielded Iron as Affected by Temperature: Prof. E. Wilson—Eddy Motion in the Atmosphere: G. I. Taylor.

ROYAL INSTITUTION, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R Inge.

ROYAL SOCIETY OF ARTS, at 4.30.—The Punjab Canal Colonies: Sir J. M. Douie.

CHILD STUDY SOCIETY, at 7.30.—Education in Early Childhood before School-Age: Miss E. A. Parish and Dr. W. P. Sheppard.

LINNEAN SOCIETY, at 8.—The Botany of the Utakwa Expedition in Dutch New Guinea: H. N. Ridley and Others.—The Genus Lernæodiscus, F. Müller: G. Smith.—The Botanic Gardens at Sibpur (Calcutta), and the Government Cinchona Plantations: Major Gage.—A New Natural Order of Flowering Plants: Tristichaceæ: Dr. J. C. Willis.—The Forced or Cultural Production of Free, Spherical Pearls; a Preliminary Note on a New Method: J. Hornell.—Some Terrestrial Isopoda from New Zealand and Tasmania; with the Description of a New Genus, Notoniscus: Prof. C. Chilton.

CONTENTS.

Editorial and Publishing Offices:
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THURSDAY, MAY 7, 1914.

CANCER.

(1) *The Pathology of Growth: Tumours.* By Dr. C. P. White. Pp. xii+235. (London: Constable and Co., Ltd., 1913.) Price 10*s*. 6*d*. net.

(2) *Researches into Induced Cell-reproduction and Cancer, and other Papers.* Vol. iii. By H. C. Ross, J. W. Cropper, E. H. Ross, H. Bayon, W. J. Atkinson Butterfield, E. Jennings, and S. R. Moulgavkar. The John Howard McFadden Researches. Pp. 149+xvii plates. (London: John Murray, 1913.) Price 5*s*. net.

(1) THIS volume seems to promise a series on the pathology of growth, under the editorship of Prof. A. E. Boycott. The venture is a welcome one showing that the move towards a closer union between pathology and physiology is making progress. Pathology is still so often restricted to, or actually confounded with, mere morbid anatomy that the wider recognition of disturbance of function—in the case of this volume of abnormality of growth—as a department of physiology proper, can only contribute both to a more wide-visioned outlook on the processes of disease, and also equally to a more critical attitude on the part of those whose sphere of activity proper is the investigation of disease, and not of normal function or structure.

For the volume as a whole we have nothing but praise, although in one relating to the pathology of growth it seems that taking up about half of it with the classification and histological structure of tumours is a liberal allowance. Especially the space devoted to Hodgkin's disease may, with profit, be omitted in future editions, since it is doubtful whether it is rightly included in a discussion of tumours proper. Since also the book is intended for students, it appears that some of this space might with profit have been yielded to the description of naked-eye appearances.

The chapters on growth, hypertrophy, atrophy, regeneration, and kindred topics are well and lucidly written. The inclusion in a text-book of pathology of a full discussion of the statistics of cancer is a welcome innovation, to which even more space might have been spared from classification, since the full significance of the statistical facts can only be brought out by giving detailed consideration to the anatomical or site distribution of cancer. Had this been done, the author would scarcely have committed himself to the general statement that cancer is increasing, since the last three annual reports of the General Register Office show that the question of the increase of cancer exists only for certain parts of the body, but not for others.

The book is, notwithstanding these criticisms, a valuable one for the student and for all who wish to have an objective review of what morbid anatomy and histology, experiment, and statistics have yielded together in the effort to elucidate cancer.

(2) The modest short title of this volume—"Researches into Induced Cell Proliferation and Cancer"—and, indeed, also the full title, do not convey adequately the enormously wide scope of the fourteen original papers which form its contents. The word "cancer" occurs in the title of one paper only: "Epithelial cell proliferation"; "The cell division of leucocytes demonstrated"; "Fibro-adenomatous nodules induced *de novo*"; "Cell division figures induced in human blood platelets"; "Treatment of wounds"; also each occur once, and presumably these are the papers for which it is claimed that "The Howard Mcfadden Researches" into induced cell proliferation bear upon cancer. The other eight papers deal with scarlet fever, measles, and syphilis, the cultivation of trypanosomes, a parasite of the earthworm, and the nature of "Kurloff's bodies" found in the leucocytes of guinea-pigs, etc.

Each subject taken up is a big one. The extent and diversity of the ground covered in this small volume of 149 pages will not cause cavil at its contents being described as researches, on the part of anyone not having precise knowledge of any of the many subjects of which it treats. Indeed, they may well marvel at the versatility displayed and the exact statements made about pitch, cancer, the classification and nomenclature of the "protozoal parasite in syphilis," and the division of polymorphonuclear leucocytes and of blood platelets. As regards syphilis, those who were present at the last meeting of the Pathological Society of Great Britain will recall the destructive criticism passed upon very similar claims regarding what was put forward as the life cycle of the cause of syphilis. The statements regarding the parasitic nature of Kurloff's bodies have not been confirmed by a recent German worker.

As regards cancer, the more critical reader will ask what leucocytes and blood plates have to do with it, and if any cancerous growth has been known ever to consist of blood platelets or polymorphonuclear leucocytes. When the statement is made that Khangri cancer "affects the women" in Cashmere, he will wonder why the men have been forgotten. When it is stated that the efforts made in the past to explain that "cancerous tissue is epithelium which has acquired malignant properties . . . have so far lacked the experimental support which enables them to rank as theories in contradistinction from hypothesis or speculations," the critical reader will again wonder if he reads aright, because there is absolutely nothing new in the particular "experimental support" adduced, namely, the results of subcutaneous injection in the ear of the rabbit. The appearances obtained are duplications of those described for the same site after the same procedure by Fischer as long ago as 1906, and by many other authors since. Furthermore, these appearances have been the subject of years of discussion among pathologists, who are agreed they have nothing to do with cancer.

As regards "adenomatous nodules produced *de novo*," the description of nodules in the ducts of the mammary gland of goats is most superficial and imperfect; but it recalls the papillomata in the bile ducts of the rabbit, found in association with coccidiosis, another familiar appearance having nothing to do with cancer.

The whole superstructure is raised on the basis of the authors' assumption that they made polymorphonuclear leucocytes divide on a microscopical slide in 1909; the result described does not separate the cover glass from the slide by its surprising amount and rapidity, but only amounts to an increase of 10 per cent. of the number of leucocytes. This, even if correct, is but a sorry achievement when it is sought to explain normal or malignant growth, and it is forgotten that bacteria add 1000 per cent. to their weight in a few hours, and the embryos of rabbits and other mammals and birds grow at least 1000 per cent. daily, without the assistance of the results of researches into induced cell proliferation.

E. F. B.

PURE AND APPLIED MATHEMATICS.

(1) *A Textbook of Elementary Statics.* By Prof. R. S. Heath. Pp. xii+284. (Oxford: Clarendon Press, 1913.) Price 4*s.* 6*d.*

(2) *A Shorter Algebra.* By W. M. Baker and A. A. Bourne. Pp. viii+320+lix. (London: G. Bell and Sons, Ltd., 1913.) Price 2*s.* 6*d.*

(3) *Key to "A New Algebra."* By S. Barnard and J. M. Child. Vol. ii., containing parts iv., v., and vi. Pp. 447–915. (London: Macmillan and Co., Ltd., 1913.) Price 8*s.* 6*d.*

(4) *Practical Surveying and Elementary Geodesy.* By Prof. Henry Adams. Pp. xii+276. (London: Macmillan and Co., Ltd., 1913.) Price 4*s.* 6*d.* net.

(5) *Practical Science for Engineering Students.* By H. Stanley. Pp. vii+166. (London: Methuen and Co., Ltd., n.d.) Price 3*s.*

(6) *Bell's Outdoor and Indoor Experimental Arithmetics.* By H. H. Goodacre, and E. F. Holmes, C. F. Noble, P. Steer. *First Year's Course* (Standard iii.), pp. 30. Price 3*d.* and 4*d.* *Second Year's Course* (Standard iv.), pp. 32. Price 3*d.* and 4*d.* *Third Year's Course* (Standard v.), pp. 39. Price 3*d.* and 4*d.* *Fourth Year's Course* (Standard vi.), pp. 39. Price 4*d.* and 6*d.* *Fifth Year's Course* (Standard viii.), pp. 48. Price 4*d.* and 6*d.* (London: G. Bell and Sons, Ltd., 1913).

(1) THIS is a delightful book that will rejoice the heart of the students of Birmingham and of many another university. No longer have we the problem of the elephant balancing upon a ball, the ball a foot in diameter and the elephant of negligible mass. In place of the old artificial kind we have, all the way through the book, entrancing problems from everyday life. In method of treatment also Dr. Heath's sympathies are of the widest. We find the link-polygon freely used, and that useful lettering device of Bow's not despised. We find graphical methods given their due place; we find bending moments duly treated; we find so many good things that the book, though apparently designed for the pure mathematician, ought to be adopted by the engineer also.

One suggestion we offer for the next edition, that kinetic friction, as in a journal (p. 208), should be distinguished from static friction, as in the freewheel friction clutch (p. 201).

(2) The Shorter Algebra is a good book of the old style. It gets all the tools ready first, beginning with seven pages of definitions and similar fundamentals. The preparation of the tools takes six chapters, formal equations come in chapter vii., and the first contact with life is found in chapter ix., in the application of equations to problems.

The method of this book is quite a good one for the able pupil who grasps the rules and enjoys the game. We fear it is valueless for the mediocre pupil, who does not see that it is a game and cannot understand the rules. He learns only to think himself a fool, which is often not the case; even if it is the case it is a mistake to let him think so. Constant contact with life is the only successful way to teach an abstruse subject like algebra to the mediocre boy.

The authors sternly refuse, while dealing with algebra, to recognise the existence of geometry. Two results dropped from the sky appear on page 103; do the authors hope to conceal their geometrical origin? If the pupils have even a suspicion, the watertight bulkheads are seriously endangered; and the authors write so clearly that we fear the pupils will actually know that a jet of geometry has pierced the algebra bulkhead.

But we must not let amusement at these foibles hide the real excellence of the book. As is to be expected from the ability of its authors, the book is one of the best of its kind. As signs of their good judgment we may mention that long multiplication and long division are marked for omission on a first reading, and that in graphs statistical curves come first.

We do not understand why the authors should say that 3·5 is nearer to 4 than to 3. If words have any meaning, either 3 or 4 may be given as the "nearest integer to 3·5."

(3) Barnard and Child's "Key" is clearly and concisely written, printed in very good type and nicely set out, and (so far as our sampling shows) correct. The good appearance is increased by appropriate use of the solidus, a symbol which is used by remarkably few writers in proportion to its real value.

(4) Prof. Adams's book contains in concise form and on the whole well-expressed all that the surveyor can possibly need for work in the town and in the country, for engineering or for railway work. We are sorry to see that the recurring decimal is still in use (p. 161). In the appendix, some questions (*e.g.*, 94, 166, 169) contain references to matter that is not supplied; it would be better to omit such questions altogether.

(5) The Practical Science consists of suitably chosen experiments, the printer's type is pleasing, and, except in the introductory chapter, the headings stand out effectively. The book covers heat, mechanics, electricity, and a number of miscellaneous things, and the student who carries out the experiments will have a good elementary equipment. The treatment of friction and the funicular polygon deserves special praise; the friction treated is kinetic, which for engineers is more important than static. The text is in general clear, but here and there it is condensed to the verge of unintelligibility. The references to the diagrams should be clearer, and the lettering of the diagrams be made to correspond to the text. Numerical results should be calculated to a suitable number of significant figures, and not left in a form involving the signs of multiplication, division, and square root.

With a little care in revision, the next edition should be really valuable.

(6) The idea of the Experimental Arithmetics is excellent. The pupil trained in this experimental way will obtain a grasp of arithmetical operations incomparably greater than was possible for the average pupil in the bookish days. And the idea is well carried out by experiments to be performed indoors and out of doors on the measurement of length, area, volume, weight, and angle.

Some secondary schools follow the rule "every lesson an English lesson," and we should like to see this rule adopted in elementary schools. When that day comes, the language of these books will need to be given greater precision; for the present time the language is sufficiently clear.

D. B. M.

BOTANICAL CATALOGUES AND MANUALS.

(1) *Catalogue of Hardy Trees and Shrubs Growing at Albury Park, Surrey.* Compiled by A. B. Jackson. Pp. viii+66. (London: West, Newman and Co., 1913.)

(2) *Lowson's Text-book of Botany.* Indian edition. Adapted by M. Willis. With a preface by Dr. J. C. Willis. Pp. xii+602. (London: W. B. Clive, 1913.) Price 6*s.* 6*d.* net.

(3) *Coconut Cultivation and Plantation Machinery.* By H. Lake Coghlan and J. W. Hinchley. Pp. xii+128+x plates. (London: Crosby Lockwood and Son, 1914.) Price 3*s.* 6*d.* net.

(4) *Genera of British Plants: with the Addition of the Characters of the Genera.* By H. G. Carter. Pp. xviii+121. (Cambridge: University Press, 1913.) Price 4*s.* net.

(5) *The Story of Plant Life in the British Isles.* Introductory volume. By A. R. Horwood. Pp. xiv + 254 + plates. (London: J. and A. Churchill, 1914.) Price 6*s.* 6*d.* net.

(6) *Catalogue of the Plants Collected by Mr. and Mrs. P. A. Talbot in the Oban District, South Nigeria.* By Dr. A. B. Rendle, E. G. Baker, H. F. Wernham, S. Moore, and others. Pp. x+157+17 plates. (London: British Museum (Natural History); Longmans and Co., 1913.) Price 9*s.*

(7) *Plant Physiology.* By Dr. Ludwig Jost. Authorised English translation by R. J. Harvey Gibson. Supplement. Pp. 168. (Oxford: Clarendon Press, 1913.) Price 2*s.* 6*d.* net.

(8) *Plant Life.* By T. H. Russell. Pp. 71. (Birmingham: Cornish Brothers, Ltd., n.d.) Price 2*s.* 6*d.* net.

(1) MR. JACKSON'S catalogue of the trees at Albury is an interesting document, especially when considered in comparison with the somewhat similar list compiled by him of the trees and shrubs at Syon. The value of the Albury list is enhanced by notes about particular trees and details as to the dates of introduction of the various species, characteristics of particular plants, uses, hardiness, etc. It is of interest to

notice that there are some remarkably fine trees at Albury, no doubt due to the soil and sheltered situation, a black Italian poplar, for instance, being about 150 ft. high, and therefore one of the tallest trees in England. The white lime and other limes, the London planes and cedars, and a special variety, var. *alburyensis* of the black walnut, a specimen of the chestnut oak of North America, *Quercus prinus*, in addition to other trees, are worthy of special mention.

(2) Of Mr. Lowson's text-book there is not much that need be said; it is one of the series published by the University Tutorial Press, and follows the usual lines of the compressed botanical text-book. This particular edition has been prepared more especially for Indian students, but this fact is not very prominent in the text, except where the more systematic side of the subject in relation to phanerogams is treated. Otherwise, both text and figures bear a very familiar, and not very inspiring, appearance.

(3) Messrs. Coghlan and Hinchley are to be congratulated on having produced a very useful and interesting work on the coconut, which should prove of considerable value at the present time when so much attention is being directed to the cultivation of the coconut palm and the utilisation of its products. The book is thoroughly practical, and also well illustrated with reproductions of photographs, which are explanatory to the text. Soil, preparation of the land, seed-nuts, pests, copra, and machinery are among the subjects of the chapters. Careful estimates are given of the profit and loss of coconut planting, from which it would seem clear that, provided a suitable site has been chosen for the plantation, its ultimate success as a paying investment is assured. In an interesting chapter on catch crops, the value of *Coffea robusta* is emphasised. Errors appear to be few, but one misprint of *s. d.* for *l. s.* in the last column of the exchange tables at the beginning of the book should be noted.

(4) Mr. Carter's book is written with the intention of familiarising students of British flowering plants and ferns with the genera arranged according to Engler's system. In dealing with the genera of ferns, the arrangement enunciated by Bower is followed.

The characteristics of the natural families are set out clearly in detail, and the genera are arranged under their tribes in key form. The book aims at directing the attention of students to a closer study of the genera of plants, a purpose which it appears admirably calculated to fulfil.

(5) Seventy-three photographs, several of which are quite pretty, appear to be the *raison d'être* of "The Story of Plant Life in the British Isles"; we cannot see otherwise why this discursive volume was published. The author in his introduction is careful to point out the faults which underlie the systems of the great botanists of history, and seems to suggest that a study of his own work will show the way of salvation. Whether the student will really become acquainted with the distinctive characters of the different families of plants by using this work would seem a matter of doubt, but he will find in these pages a considerable amount of miscellaneous information, such as the fact that daisies grow in churchyards, that there is no need to point out the characteristic features of the ivy as "any boy or girl can name it," and so on. A large number of common and local plant names are given, which is a feature of some interest, and there is a glossary of terms at the end of the volume.

(6) The Oban district of Calabar, Southern Nigeria, has yielded a rich harvest of new species and genera of plants to the indefatigable collectors, Mr. and Mrs. P. Amaury Talbot. The district, botanically, belongs to the Cameroon region, and the flora is continuous with that of the similar geological country included within German territory. In the British area, however, there is a certain admixture of plants from the Gulf of Guinea region. The Oban district is densely covered with forest, and is the home of a great diversity of species of plants; Mr. Talbot considers there are some four hundred to five hundred per square mile. With a rainfall of about 175 in., and a soil of decomposed granite and gneiss, it is scarcely remarkable that the flora should be a rich one. A striking feature of these forests is the number of cauliflorous trees, many of which were previously undescribed, six being new species of the remarkable myrtaceous genus Napoleona, the flowers of which resemble somewhat those of the parasitic Rafflesia of the east. The collection consists of 1016 species and varieties, of which 195 are new, and there are nine new genera. The plants have been determined with but few exceptions by the staff of the British Museum, and the results with various notes by Mr. and Mrs. Talbot are presented in the volume under review, which form a fitting tribute to the industry of the collectors. It should be remembered that Mrs. Talbot while in the country made a remarkable series of water-colour drawings of a great number of the plants, and in particular of the flowers of the cauliflorous tree, which it is to be hoped will soon be published in colour. The present volume is illustrated with seventeen plates of figures, in which the more striking of the new plants are figured.

The descriptions of new species occupy 119 pages, and are followed by a systematic list of the plants collected; among these may be noted *Poga oleosa* (Rhizophoraceæ), hitherto only known from the Gaboon, which is an interesting discovery, as its seeds are rich in oil. Lists of the ferns, mosses, fungi, and lichens which were collected by Mr. and Mrs. Talbot complete the enumeration.

(7) The supplement to Jost's "Plant Physiology" consists of a translation of the alterations of the second edition of the German original, and to be appreciated must be studied hand in hand with the translation of the book. Without the original translation the supplement is, of course, valueless, and even with the book it is a singularly tiresome way of presenting new information or of correcting errors. It would, we should have thought, been of more value to produce in course of time a complete new edition of Jost's lectures, since it will be impossible to continue to bring out further supplements embodying the changes in the newer German editions as they are published.

(8) The publication of the little book entitled "Plant Life" is the outcome of a desire of those who heard these lectures at an adult school to have them in permanent form. They have been published, therefore, with many of the original illustrations, and form a clear, simple, and useful account of plant life for an audience such as that to whom they were given. No doubt much of their value and charm lay in their delivery, and we cannot think that any very useful purpose has been served by the publication of these lectures beyond that of honouring the memory of one who was, no doubt, as good a teacher as he must have been an ardent friend.

OUR BOOKSHELF.

The Physician in English History. By Dr. Norman Moore. (Linacre Lecture, 1913, St. John's College, Cambridge.) Pp. 57. (Cambridge: University Press, 1913.) Price 2*s.* 6*d.* net.

THE charm of Dr. Norman Moore's historical writing rests, as such virtue must rest, on many qualities; on his wide and curious learning sitting lightly upon his pen, his humanity living in his biographical gift, and enriched by his retentive memory, and his appreciation of the past, always informed by his mastery of modern clinical medicine. As his subject for the last Linacre Lecture Dr. Moore chose "The Physician in English History"; that is to say, not a string of all the physicians of English history, but, like the sheep in the painting of the Primrose family, so many as the confines of his hour would admit. The chosen physicians were either distinguished in themselves or came into note at momentous or picturesque occasions. Thus the lecturer gave to his audience not a procession of English physicians, a great story which would indeed be welcome at his hands, but a small gallery of medical pictures set in a historical background. With the propriety of a lecturer in his university of Cambridge, he opened his discourse with Bede's unusually interpretable narrative of the disease and death of Ethelreda of Ely. The skill of Cynifrid, who, apart from the arid cram of Isidore, was probably a fairly competent "Wundaerzt," failed to save her life. Probably Cynifrid was called in too late, after long courses of monastic quackery.

Next we are taken to the death-bed of William the Conqueror, whose mortal malady is illumined by the lecturer's parallel instances from twentieth-century St. Bartholomew's.

The pages given to Linacre himself are by no means a perfunctory tribute to the founder, but a happy blend of the physician as a man of letters moving in pleasant groups amid his brilliant contemporaries of the Renaissance, Erasmus, for example, Tonstall, and More. By a deft selection of materials from a well-stored memory, Dr. Moore thus carries us century by century to the middle of the eighteenth, giving us by the way bright glimpses of Wadham in the mid-seventeenth; then to the horizon of Swift and Pope with the flash of that tantalising meteor Arbuthnot, and bringing us at length to the great lexicographer and Dr. Brocklesby. A dainty entertainment. May the author in his spare hours give us many more of such.

Text-book on Railroad Surveying. By G. W. Pickels and C. C. Wiley. Pp. ix+263. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 10*s.* 6*d.* net.

THIS book gives a fair representation of American practice in railroad surveying. The subject-matter includes brief directions for carrying out the preliminary reconnaissance in various types of country, and the location of the best route. Fuller explanations follow of the setting out of circular and spiral transition curves; this section includes turn-outs, connections, and crossings. Earthwork problems are also treated. Methods are explained of shifting the location of curves in the field from that shown on the plan in order to secure better conditions of cutting or filling. The text occupies 125 pages, and the remaining 138 pages are taken up with tables giving curve functions, logarithms of numbers, trigonometrical functions of angles and earthwork. Detailed mathematical solutions are omitted, and an elementary knowledge of surveying is assumed. Judging from the terse nature of the contents, the title "Pocket-book of Railroad Surveying" would probably be more appropriate, and would convey to engineers the fact that the book will be found to be a useful companion in his field operations.

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.]*

Crô Magnon Man: Imprints of his Hand.

While visiting lately the painted caves of the Cantabrian Mountains (north Spain) with Prof. Boule, who had kindly invited me to accompany him, I took advantage of this opportunity to study the imprints of the human hands which occur on the walls of some of those caves, notably of Castillo.

It is well known that at Gargas and elsewhere the imprints are those of a small hand, such as might have belonged to the Grimaldi race, and one such small imprint I observed in the cavern of Altamina.

But in Castillo—so admirably described and illustrated by the Abbé Breuil—I was surprised to find that all the impressions indicate an unusually large hand. With the permission of Dr. Obermaier, and the kind assistance of Mr. Burkitt, I was able to obtain tracings of seven of these, and two of them are complete enough for detailed study. One is 190 mm. in length, measured from the tip of the middle finger to the wrist, the other about 200 mm. This accords with the length of the Crô Magnon hand as indicated by the description of the skeleton given by Dr. Verneau.

This, however, is not all. When a tracing of one of the Castillo imprints is superposed on a tracing of the hand of a living subject (Englishman) having the same length, a characteristic difference is at once perceived. The fingers of the Castillo hand are shorter than those of the Englishman, and the equality in the total length is produced by the greater length of the palm. But this is a peculiarity which must have occurred in the Crô Magnon hand, for Dr. Verneau has shown that in the Mentone skeletons the metacarpals are disproportionately long when compared with the phalanges.

I have made some preliminary measurements of tracings taken from the hands of twelve tall Englishmen, ranging from 5 ft. $8\frac{1}{2}$ in. to 6 ft. $0\frac{1}{2}$ in., with a mean of 5 ft. 11 in. (thus of about the Crô Magnon stature). Dividing the length of the middle finger by the length of the palm, I obtain 0·87 as the mean index, with a range of 0·77 to 1·0; while the most complete of the Castillo hands gives 0·765 and the next best 0·72 to 0·76.

Thus the existence of two distinct races in the Aurignacian age, already indicated by the Mentone skeletons and the carved statuettes, receives additional confirmation.

W. J. Sollas.

Oxford.

Cellular Structure of Emulsions.

In reply to the letter of Prof. Kerr Grant in Nature of April 16, similar phenomena to those which he describes have been found to occur with minute motile organisms in water, and with sediments of various kinds in water and other liquids. I have given an account of some of these appearances in my paper on the effect of gravity on the movements of micro-organisms in the Transactions of the Royal Society, series B, vol. cci., pp. 333–390. I have also obtained similar groupings with the fine sediment which is formed in a hypo-alum bath, used for toning and fixing P.O.P. prints. If a small quantity of this is poured into a shallow vessel, the particles which are at first evenly distributed through the liquid soon become aggregated into groups similar to those described by Prof. Grant.

In the case of *Euglena viridis*, the living organisms in the dark become aggregated into groups as shown in Fig. 1, the central dark mass in each group consisting of a stream of Euglenæ moving downwards, the lighter peripheral area consisting of Euglenæ moving upwards. Various sediments when allowed to settle in liquids become aggregated in a similar manner, but without the continuous up and down movements. Thus Fig. 2 shows a sediment of osmium dioxide settling in dilute glycerine, which closely resembles the aggregation of the living cells shown in Fig. 1

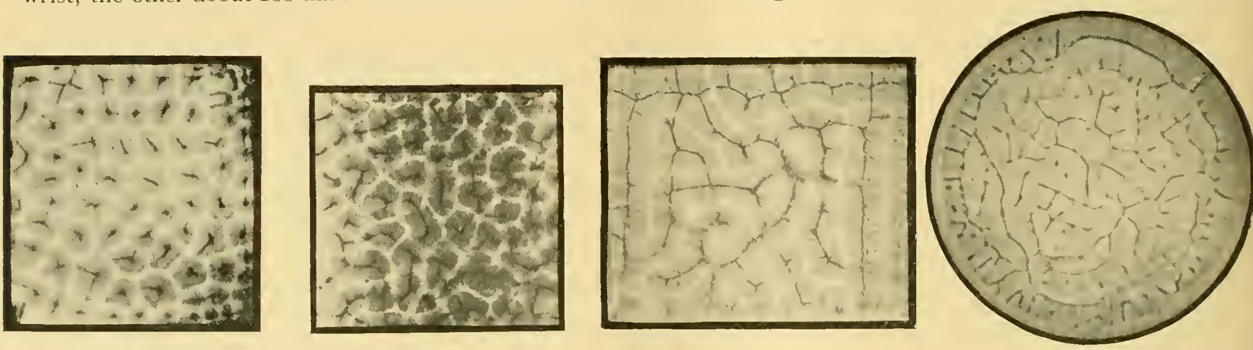


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

In all the cases observed by me the regular grouping appears to be preceded by the formation of a network, as shown in Fig. 3, formed by manganese dioxide settling in a solution of gum arabic. Again, if a readily oxidisable photographic developer is poured into a flat dish to form a layer about 1/16 in. deep, the brown oxidised film which forms at the surface is at once broken up into a network, Fig. 4, which gradually becomes resolved into separate groups.

I have suggested that these groupings are in all probability cohesion figures, and that they may be related to the beautiful cohesion figures described by the late Mr. C. Tomlinson in the *Philosophical Magazine* for 1861 and 1864. They are probably formed whenever we have fine particles free to move, placed under such conditions that a force or forces, acting in opposition to the cohesion of the particles, can be brought into play. Cohesion, surface tension, diffusion currents, and gravity are among the forces probably concerned in the effects observed.

Prof. Grant's suggestion that the flocculi in the solar photosphere and in cloud formations of flocculent type may be related to this phenomenon is interesting. Such flocculent appearances can also be observed, under certain conditions, in ponds and pools which contain dense aggregations of motile micro-organisms, and I have very little doubt that the network-like and flocculent appearances so often observed in the froth which is formed when the tide breaks on the seashore may be explained in a similar manner.

HAROLD WAGER.

West Park, Leeds, April 14.

An Extension of the Spectrum in the Extreme Ultra-Violet.

THE researches of Schumann led him to extend the spectrum to the neighbourhood of wave-length 1250. His limiting wave-length was determined by the absorption of the fluorite which formed a necessary part of his apparatus. In 1904 I succeeded in pushing the limit to wave-length 1030 by the use of a concave diffraction grating.

Recently I have renewed the attack on the problem, with the result that I have succeeded in photographing the spectrum of hydrogen to wave-length 905. The extension is due, not so much to any fundamental change in the nature of the apparatus as to an improvement in technique consequent on an experience of ten years.

It is a characteristic of the region investigated by Schumann between wave-lengths 1850 and 1250 that, while hydrogen yields a rich secondary spectrum, with the possible exception of one line, no radiation has been discovered belonging to the primary spectrum. On the other hand, in the new region between the limit set by fluorite and wave-length 905, a disruptive discharge in hydrogen produces a primary spectrum of great interest made up of perhaps a dozen lines. These lines are always accompanied in pure hydrogen by members of the secondary spectrum, but they may be obtained alone if helium containing a trace of hydrogen is employed.

Results obtained from vacuum tubes when a strong disruptive discharge is used, must always be interpreted with caution since the material torn from the tube itself sometimes furnishes impurities. In the present case, it will be some time before the effect of such impurities can be estimated. However, it may be stated with some degree of certainty that the diffuse series predicted in this region by Ritz has been discovered. The first member at 1216 is found to be greatly intensified by the disruptive discharge, and the next line at 1026 appears also, though very faintly. This diffuse series bears a simple relation to Balmer's formula. Following the same kind of argument, a sharp series corresponding to the Pickering series might be expected. The new region appears to yield two lines belonging to such a relation at the positions demanded by calculation.

THEODORE LYMAN.

Harvard University, April 20.

The Structure of Atoms and Molecules.

SINCE in an elaborate criticism of Bohr's theory on the constitution of atoms and molecules, Prof. J. W. Nicholson, as in his letter to NATURE (February 5, p 630), comes to the conclusion (*Phil. Mag.*, xxvii., p. 560, 1914) that the valencies of lithium, beryllium, boron, etc., on Bohr's theory are not in accord with experience, and if the electrons in the atoms are to be in one plane, we must either abandon Bohr's method of calculating valency—and (generally) Bohr's theory of the atoms more complex than hydrogen and helium—or give up van den Broek's hypothesis, that the charge of the nucleus of Rutherford's atom is equal to the atomic number (which hypothesis was accepted by Bohr as one of his fundamental assumptions), I may be allowed to add some remarks to my previous letter on this subject (NATURE, March 5, 1914).

For these atoms at least this hypothesis is a mere expression of experimental facts. The hydrogen atom is known to lose never more than one electron, and the helium atom never more than two, and, of course, never one to form an electrolytic ion, while lithium, beryllium, boron, and carbon can lose, or, in chemical combination, dispose of 1, 2, 3, 4 electrons respectively. Further, the number of electrons per atom has been proved to be nearly equal to half the atomic weight (Rutherford, Barkla), and in the case of carbon to be six (Rutherford, *Phil. Mag.*, vol. xxvi., p. 711, 1913). Since the number of electrons per atom must be an integer, here, at least, no other solution seems to be possible than that the number of electrons per atom surrounding the nucleus, and hence the nuclear charge, is equal to the atomic number.

Further mentioning Moseley's previous experiments on high-frequency spectra (undertaken for the express purpose of testing the atomic number hypothesis), and criticising the theoretical deductions, derived by Moseley from these experiments, Nicholson concludes that they have shown no relation to Bohr's theory (*loc. cit.*, p. 564). Now in another paper Moseley, from further experiments on high-frequency spectra, proves (*Phil. Mag.*, vol. xxvii., p. 703, 1914) that the frequency of any line in the X-ray spectra is approximately proportional to $A(M-b)^2$, where A and b are constants for each series, and M, the atomic number (called by Moseley N) of the element, is identified with the number of positive units of electricity contained in the atomic nucleus, so that these experiments "give the strongest possible support" to this atomic number hypothesis (*loc. cit.*, p. 712). The number of rare-earth elements as given by Moseley is the only exception.

That b is much larger for the "L" lines than for the "K" lines suggests, according to Moseley (in agreement with my own views, NATURE, December 25, 1913) that the "L" system is situated the further from the nucleus. If so, b=the number of electrons nearest the nucleus, and not$=\sigma_n$, the term arising from the influence of the electrons in a ring on each other, and, for the "K" lines, n, like b, must be unity, as calculated by Nicholson on Bohr's theory. For the "L" lines, according to Moseley, $b=7\cdot4$, but it can easily be seen from the tables that if $(M-b)$ be here augmented by 0·8 per cent., all values are integers ($\pm0\cdot2$), and $b=7$ and $n=1$ again, but perhaps the factor 5/36 in Moseley's interpretation cannot be retained.

Hence, though this number 7 requires confirmation, principally, for the "K" line at least, Bohr's theory is here in agreement with Moseley's experiments, and with the atomic number hypothesis. Not only the frequencies, but also the minimum velocity of electrons required to excite this radiation, and the absorption of it (in aluminium) have been proved (*loc. cit.*) to depend on the atomic number very nearly, and Nicholson's conclusion that the atomic numbers are not correct does not hold, for $(M-b)$, not M, is one unit less for the K radiation than the corresponding atomic number. But, from analogy, Bohr's lithium atom, as well as Nicholson's ring of three electrons, must be given up, for of three, one electron (b) must be very near the nucleus, one (n) near but outside this first one, and one as electron of valency must be peripheric.

Further, the velocity of electrons, required to excite this radiation, according to Widdington equal to $10^8\times$atomic weight cm./sec., is more accurately equal to $2\cdot24\times10^8(M-1)$ cm./sec., than for Cr, Fe, Ni, Cu, Zn, and Se; the last formula gives for the constant reduced to unity 0·99, **1·04**, 1·02, 1·00, **0·97**, 1·00, while the first gives 0·99, 1·05, **1·06**, 0·99, 0·98, **0·94** respectively. Since the absorbability of the excited radiation is only about 3 per cent. greater than that of the exciting one, and is about inversely proportional to the sixth power of the atomic number, we get $v=2{\cdot}23\times10^8(M-1)$ cm./sec., while Bohr finds $(M=N)$:

$$v=2{\cdot}18\times10^8N \text{ cm./sec.}$$

Now from this value of v, and $\nu=2{\cdot}47\times10^{15}(M-1)^2$, we can calculate x from $xmv^2=2h\nu$, which must be a constant, because both v^2 and ν depend on $(M-1)^2$. As $mv^2/2$ is energy to be, at least in part, radiated away periodically, on the right side of the equation, not only the number of times energy is radiated away per second (ν), but also the total time of radiation (t) and the mean energy radiated away per period (E) must occur, so that $xmv^2=2t\nu E$, and tE is a constant (which may mean only that the time during which radiation is emitted is inversely proportional, for a given frequency, to the quantity of energy that is radiated away during each period). Hence

$$x=2h\nu/mv^2=2.6{\cdot}62\times10^{-27}.2{\cdot}47\times10^{15}(M-1)^2/0{\cdot}88\times10^{-27}.2{\cdot}23^2\times10^{16}(M-1)^2=0{\cdot}748, \text{ or } 3/4,$$

as assumed by Moseley.

From $mv^2/a=e^2(M-1)/a^2$ we can calculate $mav=e^2.(M-1)/v=4{\cdot}78^2\times10^{-20}(M-1)/2{\cdot}23\times10^8(M-1)=1{\cdot}03\times10^{-27}$, while $h/2\pi=6{\cdot}62\times10^{-27}/2\pi=1{\cdot}05\times10^{-27}$, so that $mav=h/2\pi$, as assumed by Bohr, and

$$a=5{\cdot}12\times10^{-9}(M-1)^{-1} \text{ cm.}$$

All this is in agreement with Bohr's theory.

As may be seen from a previous letter (NATURE, March 5, 1914, p. 7), some properties of the elements depend not on the atomic but on the "periodic" number $P=8r\pm p$ (r is the number of horizontal rows preceding that of the element period of rare-earth elements not counted, and p the maximum or positive valency). Now the sum of these electrons of valency may be easily seen to be for all regular (non-elementar) inorganic molecules an integer multiplum of eight. Hence the same holds for the sum of all P electrons in these molecules (ions and rare-gases-atoms included). Affinity is then the tendency to build up systems of $8n$ P-electrons, and, of course, if such a molecule breaks up into atoms with each similar systems of $8n$ P-electrons, such ions must be formed as known from electrolysis. The great facility with which molecules like H_2O, NH_3, HCl, though neutral, are added to such systems, may be due to each of them, containing 8 P-electrons. According to Bohr, rings of electrons, whether belonging to one or to more atoms, may unite if the number of electrons in both is equal, so that rings of 2, 4, and ultimately 8 will be the most probable (16 only if the charge is very great).

Of course, the objections to the "Saturnian" atom hold for such systems also. Indeed, the structure of the periodic system as a whole, and the curious relation between the number of the non-periodic (Q) elements, H, He, Co, Ni, Rh, Pd, and that of the horizontal rows in the periodic system: 2/1, 2/2, 2/3, 4/3, 4/4, 4/5, 6/5, 6/6, 6/7, suggests systems of n equal non-coplanar rings of 8 electrons surrounding one or more (even n), positive nuclei, with n or $n\pm1$ electrons in or near the axis, and additional rings of electrons of valency, rather than a Saturnian atom. But, generally speaking, Bohr's theory is not in disagreement with the atomic number hypothesis.

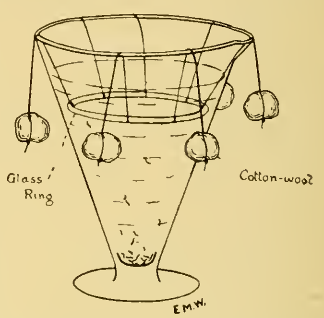
A. VAN DEN BROEK.

Gorsel (Holland), April 15.

Means of Collecting Eelworms.

THE rhubarb, when cultivated as a field crop, is subject to a wasting disease, which, attacking the root-stock and causing it to decay, occasions considerable loss to the grower. The diseased tissue, when examined, is frequently found to be infested with the stem eelworm, *Tylenchus devastatrix*, Kuhn, and, in districts where this disease is prevalent, a supply of Tylenchus material is at hand which, since the rhubarb is a perennial plant, is available not only in summer but during winter also.

When pieces of decaying rhubarb tissue are enclosed in a corked tube, any Tylenchus worms that are present migrate to the surface and, provided they have not been corked up too long, will, if placed in water, remain alive for weeks. Material can be obtained in quantity, and with very little delay, by placing pieces of rhubarb in a strainer covered with fine gauze, and suspended in a vessel of water. The eelworms, forsaking their feeding-ground, wriggle through the muslin and accumulate in a writhing mass on the floor of the vessel. This water method, it may be added, is also useful in examining the eelworm fauna of soil samples, and provides a simple means of ascertaining roughly what forms are present.



When thus collected from rhubarb, the eelworms are usually mixed with sediment, but this defect can be remedied by placing the material, while still unsorted, in a porous vessel, such as a candle-filter, which, when placed in water, allows only living eelworms to pass through. A better method of cleansing the material, however, is obtained by taking advantage of the habit that eelworms have of climbing up capillary films when these are present. For this purpose, silk threads are employed, to each of which is suspended a blob of cotton-wool, the cotton-wool serving as a receptacle for holding the crude material obtained from the rhubarb. The upper ends of the threads are attached to a glass ring which is supported upon the sloping sides of a funnel-shaped vessel containing water—this shape being chosen in order that the blobs may hang clear.

As the threads become saturated, the eelworms, leaving all impurities behind in the cotton-wool, ascend amongst the silken strands, and, passing over the brim into the water, congregate on the floor of the vessel—a feat on their part which, besides providing the student with clean material, raises the question whether, in respect of their acrobatic accomplishments, eelworms vary to any appreciable extent; and, if so, whether the rough method here described can be extended so as to provide a means of sorting out one species from another, when two or more species are present in the material employed.

M. V. LEBOUR.
T. H. TAYLOR.

The University, Leeds.

THE PROHIBITION OF EXPERIMENTS ON DOGS.

THE Dogs' Protection Bill for the second reading of which 122 members of Parliament were induced to vote the other day is one of those measures which are born of ignorance and fostered on misrepresentation. All our knowledge of the functions of the body is fundamentally based on experiments which have been made upon dogs. The action of the heart and its nerves; the mechanisms of circulation, respiration, digestion, and secretion; the functions of the liver, pancreas, and kidney; the processes of metabolism, the causation of diabetes; the utility of the internally-secreting glands; the manner in which the organs of the body are governed and their functions regulated—none of these could have been elucidated nor could the knowledge which has been obtained have been applied to man from experiments upon animals other than dogs. The prohibition of the employment of dogs for these investigations would put a complete stop to the progress of physiology in Great Britain—which, in this particular science, has, from the time of Harvey onwards, always held a peculiarly honourable position. It would put medicine in this country at an enormous disadvantage as compared with other countries; and our professors and students would have to go abroad to gain that practical knowledge of the functions of the body for the investigation of which the dog is the only animal available. For medicine is founded upon an exact knowledge of these functions: without it the physician gropes in the dark and works by guesses which are generally far removed from the actual truth. Moreover many diseases which are common to man and animals can only be fully investigated in an animal like the dog, unless man himself is to be made the subject of experiment. And it is scarcely necessary to point out even to our opponents that the prohibition they demand would prevent any further investigation of the causation and treatment of diseases which are peculiar to the dog, so that the race they are professing to protect would ultimately suffer from such prohibition even more than mankind.

The question really at issue is whether a knowledge of the functions of the body in health and disease is to continue to be gained at the expense of a certain number of stray and worthless dogs, which are in any case condemned by law to be destroyed, or at the expense of humanity. Nothing is more certain than that important branches of medical knowledge if not advanced by experiments on these animals can only be advanced by taking toll of the lives of patients, who would be treated in ignorance of the conditions under which remedies should be applied and of the results which such remedies are likely to yield.

It is difficult for a layman to understand the full bearing of this question, because he is unaware of the extent to which medical knowledge profits and has profited by experiments on animals. Some doctors even, mostly belonging to what is often spoken of as the "old school," are uninformed regarding the manner in which their knowledge of the functions of the body and of the changes which are produced in disease has been acquired. It is, moreover, true that the ordinary practising physician does not himself make experiments upon animals: he has as a rule neither the time nor the opportunity. But however well-trained he may be, it is not the practitioner who advances our knowledge of medicine and surgery; or if he does so it is at the expense of the patient upon whom he first makes a trial of the remedies by aid of which he hopes to cure the particular disease he is treating. There are, admittedly, operations which have been tried from the first upon the human subject and have ultimately resulted in singular success, so that cases which previously would have been relinquished as hopeless are in large numbers restored to health. But the toll of human lives required to achieve this success is lamentable. Surgeons who devise a new method of operation are in the habit of publishing statistics regarding the cases which they have treated by it. An examination of such statistics always shows a relatively large percentage of failures and death in the earlier cases, whilst that percentage is greatly reduced or even abolished in the later cases. This means that the earlier cases have partaken of the nature of experiments by the aid of which the technique of the method has been established. If this technique had been worked out in dogs the toll of human life required to arrive at the same degree of perfection would have been vastly less.

There are, however, surgeons of the present day—and their number is likely to increase in the future—who consider it improper to acquire at the expense of their patients the technical knowledge necessary for the establishment of a new operative method and who would willingly resort to dogs for the purpose of obtaining such knowledge. This procedure can, however, be but rarely carried out in this country, because the anti-vivisectionist legislation of recent years places serious obstacles in its path. But in the United States, where a more enlightened view is taken of the position of mankind in relation to the lower animals, it is the recognised method of procedure, and is beginning to make itself felt in the extraordinary progress which the science and practice of surgery has made of late years in America.

Sir Frederick Banbury has attempted to excite sympathy for his Bill by citing the case of a dog which had been operated on by an eminent Edinburgh surgeon, with the object of testing a new method of inducing union of fractures of bone. Surely nothing could be more proper than that a new method should be first performed upon a dog rather than upon man. Does Sir Frederick Banbury think that it would have been right for the test to be first made upon a patient? Would he prefer to have an untried method applied to himself before it had been determined, by experiments upon dogs, whether it could be successfully performed or would be likely to yield a good result? I think the Edinburgh dog is an unfortunate instance for Sir Frederick to have selected. And I cannot, of course, expect him to see that the fact that the dog, which was bought in good faith from a known dealer in animals, happened to have been picked up in the street by the vendor, has nothing to do with the question whether it is or is not expedient to employ dogs for this and similar purposes.

Sir Frederick Banbury is commonly believed to be impervious to argument and one can well understand that this may be so; otherwise he would surely be able to see that the very statistics which he gives regarding the number of dogs utilised in this country for medical research furnish the strongest of arguments against his Bill. Does he think that men who are engaged in these researches *prefer* to employ dogs, and insist on using them, rather than cats or rabbits or guinea-pigs—for which Sir Frederick evidently has but little sympathy—for no other reason than the sheer desire to vivisect them rather than other animals which are far cheaper and more easily obtained? Is he not able to understand that dogs are never employed and are never likely to be employed for experiments unless there is some special necessity for using these animals rather than others? At any rate he may accept my assurance that it is so. And it follows that the greater number of dogs he can show to have been used the stronger is the argument for the necessity of using them. Not that his statistics are of much account, for in attempting to strengthen his case for dogs, he mixes cats up with them—unless the report of his speech is in this respect inaccurate.

But Sir Frederick Banbury's inability to assess evidence is sufficiently manifested by his argument that because the Royal Commission did not specifically state in its report that it is necessary for dogs to be employed it found no evidence sufficiently strong to authorise it to make such a statement. We know, as a matter of fact, that the Commission did discuss the question whether the exclusion of dogs might be recommended and definitely concluded against the adoption of this course. Is it, perhaps, possible that Sir Frederick Banbury—who puts himself forward as a judge in this matter—has not himself read the evidence which was presented to the Commission on the subject? This is the only hypothesis that I can suggest to render his position intelligible. But this hypothesis cannot be applied to Col. Lockwood, who appears as Sir Frederick's chief supporter—since he was a member of the Commission. Although he does not dare to say that the evidence before the Commission proved that the use of dogs is not necessary, he alleges that it did not distinctly prove "to anyone with a fair mind" that the dog alone is necessary for those "so-called scientific experiments" (*sic*). And this in spite of the fact that it had been proved to demonstration before the Commission—what is, of course, well known to any person who has any medical knowledge worth speaking of—that most of what we know regarding the functions of the body could only have been elucidated with the aid of experiments on dogs.

Col. Lockwood is, however, good enough to inform us by what consideration he is guided. He is "not ashamed to say that he is actuated by sentiment." But there is sentiment and sentiment, and we may be permitted to inquire what kind of sentiment it is that actuates Col. Lockwood. Sentiment is feeling and Col. Lockwood's feeling is for the lower animals in general, for dogs in particular, and probably—if it were to be still further analysed—most particularly for the special dog which, as he tells us, he leads about London on a string. His sentiment does not extend to humanity. He has no feeling for his own species. He prefers that mankind shall continue to be ignorant, and shall continue to suffer as a result of that ignorance, rather than that his feeling for dogs, most of which do not in any way suffer, shall be harrowed.

Sentiment of this sort has no true ring: it is *false* sentiment; and any man—let alone a legislator—should be ashamed to confess that he is actuated by it.

Further, Col. Lockwood is good enough "not to wish to accuse his opponents of not being so humane as himself." But Col. Lockwood's humaneness is—like his sentiment—*false*: it leaves humanity out of consideration. He may take it from me that his opponents repudiate this kind of humaneness and thank him neither for the comparison nor for his eulogium of their profession. Of what value is eulogium coming from such a quarter? If he and his 121 fellow-members accept the services of medical men, are they not benefiting by the very experiments they denounce? To be consistent they should resolutely decline to call in the aid of physician or surgeon and betake themselves to the Christian Scientist or to any other quack they may fancy. But it is as hopeless to look for consistency from anti-vivisectionists as to expect to gather figs from thistles. As for the voters who send such persons to Parliament, one may well apply to them Carlyle's estimate of most of his fellow-citizens. But perhaps they are, on the whole, not inappropriately represented there.

E. A. SCHÄFER.

THE TREVOR LAWRENCE ORCHID COLLECTION AT THE ROYAL GARDENS, KEW.

WHEN the late Sir J. J. Trevor Lawrence, Bart., died, an announcement was made that his well-known orchid collection at Burford had been bequeathed to Lady Lawrence with an expression of his wish that such of the plants as were especially of botanical interest should be presented to the Royal Botanic Gardens, Kew. This gift has now been made to the national orchid collection there, which has received from Lady Lawrence a large selection consisting of 580 plants, belonging to 89 genera, and representing 350 species mainly, but by no means exclusively, of botanical interest.

The character of the collection brought together by Sir Trevor at Burford during many years was a matter of general knowledge. It was singularly rich in rare and interesting species, owing to the fact that Sir Trevor at all times paid especial attention to whatever in the natural family was striking or unusual from a morphological point of view, apart entirely from any decorative value which it might possess. The result of this was that the Burford collection was not only thoroughly representative of the usual showy species and hybrids and on this account to be reckoned with in the horticultural world, but also possessed examples of most of the cultivated genera, some of which are seldom met with, and, on this account, was perhaps as important from the scientific as from the gardening point of view. It included plants from almost every quarter of the globe demanding the most diverse cultural treatment.

The magnificent selection from the collection at Burford now transferred to Kew is rich in such genera as Bulbophyllum, Cirrhopetalum, Pleurothallis, Maxillaria, Epidendrum, Eria, Angræcum, Dendrobium, and Cœlogyne, and includes many species and a few genera not previously represented at Kew, some of these being rarely seen in cultivation. The genera not previously present in the Kew collection include Trichoceros, a high Andine genus very difficult to bring home alive and very difficult to cultivate afterwards, Nasonia and Quekettia, two small American genera, and Stereochilus and Sigmatogyne from Northern India. The collection also includes a number of undetermined species which have not yet flowered; in a few cases the genus to which these belong is still doubtful. These unknown plants have been derived from various sources; some of them are plants contributed to the Burford collection by Sir Trevor's son, Captain C. T. Lawrence, by whom they were obtained in West Africa.

PROF. EDUARD SUESS, FOR.MEM.R.S.

BY the death of Eduard Suess on April 26, Austria loses her most eminent man of science, and the world one of its greatest naturalists. The son of a German merchant, domiciled in this country, Suess was born in London on August 20, 1831. The family removed, while he was still young, first to Prague and then to Vienna—but to the end of his life Suess retained his affection for what he used to call his "native land," and maintained the most cordial relations with his numerous English friends. His university career was commenced at Prague, but completed in Vienna, and at the age of twenty-one he became an assistant in the geological department of the famous Natural History Museum of the latter city. Here he worked for five years on the collections, and, as the result of his studies, published a number of important papers on graptolites, brachiopods, and other fossil forms.

It was in 1857, however, that Suess entered upon what was his life's great work—that of a teacher. After serving ten years as an extraordinary professor in the University of Vienna, he was in 1867 appointed to the full professorship of geology, a post which he held for thirty-four years, retiring as emeritus professor in 1901. Of his success as a teacher it is needless to speak, for he numbered among his pupils Neumayr, Mojsisovics, Fuchs, Waagen, Penck, and other distinguished geologists, many of whom caught from their master that grasp of detail, combined with powers of generalisation, that so eminently distinguished him. The writer of this notice recalls with pleasure the happy time he spent with Suess forty years ago, when he had the opportunity of witnessing the delightful relations that existed between the professor and his students. Not only during geological excursions in the neighbourhood of Vienna was the charm of Suess's society felt, but in the Wurstel-Prater, where we joined the young fellows during hours of relaxation—in the beer-gardens, and even on the "merry-go-rounds." Yet, amid all the fun and frolic, the signs of affectionate respect and devotion to the great teacher were never for a moment wanting.

It was at this time that Suess's daughter became engaged to his most distinguished pupil, the young Bavarian, Melchior Neumayr. After working for a time on the Geological Survey of Austria, Neumayr had established a great reputation as a palæontologist, and at the age of twenty-eight became a colleague of Suess, as professor of palæontology in the Vienna University. Greatly impressed by reading the "Origin of Species," he entered into correspondence with Darwin, by whom his work was held in high estimation, and in the end he came to be regarded as the stoutest champion of evolution on the geological side.

Suess's own researches ranged over every branch of geological science, as may be seen from the titles of sixty memoirs and books published by him prior to 1875. But in this year there appeared his remarkable work, "Die Entstehung der Alpen," to be followed five years later by the first part of the still more famous "Antlitz der Erde." In this great work, which engaged his labours during twenty-five years, Suess aimed at no less a task than taking a comprehensive survey of all that has been accomplished in elucidating the geological structure of every part of the globe, and drawing general conclusions from that survey. How admirably this herculean undertaking was performed is told—with an estimate of the great merits, the small defects, and the enormous influence exerted by this monumental work—by Sir Archibald Geikie in a contribution to the series of "Scientific Worthies" (see NATURE, vol. lxxii., May 4, 1905). It will suffice here to say that the book will undoubtedly take its place as a scientific classic, side by side with Hutton's "Theory of the Earth" and Lyell's "Principles of Geology."

In 1890 there came a sad interruption to Suess's scientific labours. His distinguished son-in-law and colleague, Neumayr, died at the early age of forty-four, when only the first volume of the great work on which he was engaged, "Die Stämme des Thierreichs," had been published. It is very touching, even at this date, to read the letters in which Suess wrote of his great sorrow to his friends; but fortunately these same letters contained the expression of a new hope, founded on the fact that his own son had just taken his doctor's degree in geology. Happily, Suess lived to see his son become an extraordinary professor in the University, to find him the author of valuable geological papers, and, shortly before he passed away, to witness the son installed in the chair vacated by himself only a few years previously.

The great task of his life completed in 1910, Suess's closing years have been happy and restful, for only quite recently came the bronchial affection which terminated his life in his eighty-fourth year.

Suess held much the same position among German-speaking peoples as did Huxley among English and Americans. They both held that, in addition to their scientific labours, however exacting these might be, something in the way of service was due to the cities in which they lived and the states to which they belonged. In 1862 Suess had directed attention to the unsatisfactory condition of the water-supply of Vienna, and, from 1863 to 1873, he was called upon to serve as a member of the Municipal Council of Vienna; it was due to his initiative in this capacity that an aqueduct, 110 kilometres long, was built to bring water from the Alps to the city, and that other great improvements in the sanitary conditions of Vienna were undertaken. For more than thirty years he was a member of the Lower House of the Reichsrath, and proved himself a doughty champion against the defenders of political privileges and of clericalism. Like Huxley, he declined many offers of honours and titles from the State, but was amply compensated by the marks of esteem from his fellow-workers in science. He was president of the Austrian Academy of Sciences, a member of the French Institute, Foreign Member of the Royal Society since 1894, and member of scientific societies in every part of the world. He received the Wollaston medal of the Geological Society in 1896, and the Copley medal of the Royal Society in 1903.

John W. Judd.

ROBERT KAYE GRAY.

It is with deep regret that we have to record the death of Mr. Robert Kaye Gray, who passed away on April 28, at Brighton, after a long illness, at the age of sixty-two. He was well known as the managing director of the India-Rubber, Gutta-Percha, and Telegraph Works Co. at Silvertown, but his interests extended far beyond the range of commerce, and he became associated with many institutions and societies for the improvement of natural knowledge, and for the welfare of the sick and needy. His attractive personality, his quiet way of doing good, his unbounded generosity, the breadth of his mind, and his exceptional store of worldly wisdom, made him the centre of a multiplicity of activities; and there is no doubt that in recent years the constant demand made upon his powers and judgment hastened the end of his remarkable career.

Readers of Nature will recall how large a share Mr. Gray took in establishing and supporting the National Physical Laboratory. He had the satisfaction of seeing the laboratory extend in scope and usefulness, and his name will always be associated with that of the late Sir William White in the pioneer work of giving direction to its latent possibilities. His loss will be keenly felt by the Institution of Electrical Engineers, of which he was a past president, by the Royal Society of Arts, and the Institute of Metals, to which he rendered substantial help.

The cause of technical and university education in London has also suffered by the loss of Mr. Robert Gray, who gave freely of his time and from the fund of his experience to aid in their advance. His association with submarine telegraphy brought him into touch with engineers and others in every quarter of the globe, and it is not too much to say that he was universally esteemed and honoured.

From his father, the late Matthew Gray, an engineer of high ideals and remarkable strength of character, Mr. Gray inherited a mind intent upon accomplishing large things by straight means. Early in his professional life he set himself to master every branch of submarine telegraph engineering, including the manufacture, laying, and testing of cables. This knowledge and experience was the basis of his subsequent professional work, and it led him ultimately towards that field of natural science of a practical kind, which afforded him full scope for his energies. In the history of the progress of the age through which he passed he must be assigned a place as a representative man, and as a man of affairs. He was representative of the age in which commerce became a science, and science a refining influence —the age in which science was at last seen to be consistent with benevolence.

NOTES.

America has lost one of her foremost astronomers by the death, in his seventy-seventh year, of Dr. George William Hill. He graduated at Rutgers College in 1859, and in 1861 became an assistant in the office of the American Ephemeris and Nautical Almanack. He afterwards became chief of this publication. From 1898 to 1901 he was lecturer in celestial mechanics at Columbia University, New York. In 1887 the Royal Astronomical Society awarded him its gold medal for his researches in connection with the lunar theory. He was a foreign member of that society, and also of the Royal Society, and a corresponding member of the Institute of France. In 1892 Cambridge University conferred on him its honorary Sc.D. He was president of the American Mathematical Society from 1894 to 1896. In 1905 the Carnegie Institution published a volume of his collected mathematical works, with an introduction by Henri Poincaré. Dr. Hill was also the author of a work on "The Theory of Jupiter and Saturn."

Mr. C. S. S. Peirce, an American mathematician and logician of international reputation, has died at the age of seventy-four. He was a son of Prof. Benjamin Peirce, of Harvard, and was himself educated at that University. For a few years he was a teacher of logic in Johns Hopkins University, and he gave occasional lectures at Harvard, but the greater part of his life was devoted to study and research. Since 1887 he had lived in seclusion in a little cabin in the mountains near Milford, Pennsylvania, where he had collected what is believed to be one of the most complete private reference libraries in the world on the subjects in which he was interested. He edited several of his father's mathematical works, and was the author of "Photometric Researches," as well as of numerous papers on logic, the history of science, psychology, astronomy, optics, colour sense, map projections, chemistry, engineering, early English pronunciation, library cataloguing, etc. Mr. Peirce was one of the pioneers of symbolic logic, and was the first to formulate the philosophical principle which he named "pragmatism." He dissented, however, from Prof. William James's development of this principle.

WE regret to record the death, in Paris, of M. Wilfred de Fonvielle. Few men have done more to popularise the subject of aeronautics than M. de Fonvielle, who not only wrote numerous books and articles, both popular and scientific, upon the subject, but also did much practical work, especially in regard to balloons. Commencing life as a journalist, he joined the staff of a journal, *La Presse Scientifique*, edited by M. Barral. The latter had just been making his well-known balloon ascents for scientific observation, which greatly interested the young enthusiast and started him writing articles on the subject. Since then, until recently, his pen had but little rest. His principal works are:—"La Science en Ballon" (1869); "Voyages Aériens" (with Glaisher and others) (1871), translated into English; "Les Ballons pendant le Siège" (1871); "Traité Pratique de Navigation Aérienne" (1872); "Aventures Aérienne" (1876), translated into English; "La Conquête de l'Air" (1882); "Notre Flotte Aérienne" (1908); and a vast number of articles in French and English papers and magazines, including many contributions to our columns. De Fonvielle's first balloon ascent was made in the great *Géant*, with M. Nadar, in 1867. Numerous other journeys followed, until he became considered one of the leading aeronauts in France. During the siege of Paris he piloted one of the balloons which left that city, descending in Belgium, whence he crossed to England. In later years he paid frequent visits to this country, where he several times made balloon ascents. For some years he was president of the Société Française de Navigation Aérienne.

BOTANISTS will learn with regret of the death, at seventy-five years of age, of M. van Tieghem, member of the Institute of France, professor at the Natural History Museum, Paris, and one of the most eminent of modern workers in the field of botany. As a young man he worked under Pasteur, and he made valuable contributions to science in the domain of bacteriology. In 1873 he published, in conjunction with his pupil, G. Le Monnier, a monograph on the Mucorineæ, in which the morphology and physiology of the family were carefully studied, and a detailed systematic account was given for the first time. Two further contributions on the same subject appeared in 1875 and 1876. But van Tieghem is best known for his work on the anatomy and morphology of the seed-plants. In 1866 appeared an important paper on the anatomical structure of the Aroideæ, and his concluding remarks supply the key to his work in this field. He says:—"Nos observations semblent démontrer aussi par une preuve nouvelle qu'il est indispensable de joindre l'étude anatomique comparée de l'appareil végétatif à celle de la fleur, si l'on veut construire le système idéel à liaisons fixes qui est l'objet de la méthode naturelle." The systems of classification which he proposed were, however, the least valuable part of his work; they indicated lack of appreciation of the relative value of characters, and were hampered by a cumbersome terminology. On the other hand, his work on the comparative anatomy of the female flower and fruit of the Gymnosperms was of fundamental value. In 1882 he succeeded Decaisne as botanical editor of the *Annales des Sciences Naturelles*, a post which he held until his death, and the long series of memoirs in this journal by himself and his pupils on the morphology and anatomy of various families and genera of seed-plants will form a permanent monument of his industry and botanical work.

THE Bruce medal of the Astronomical Society of the Pacific has been awarded to Dr. O. Backlund, director of the Pulkowa Observatory.

Science announces the retirement, on July 1, after twenty-one years' connection with the Yerkes Observatory, of Prof. S. W. Burnham.

THE Wellcome Historical Medical Museum is to be reopened on May 28, at 54*a* Wigmore Street, as a permanent institution in London. Since the closing of the museum in October last the collections have been much augmented and entirely rearranged.

IT is announced in *Science* that the amount subscribed in connection with the jubilee celebration of Dr. A. Auwers has been handed to the Berlin Academy for the foundation of a prize (to be known as the Bradley Prize) to be awarded once every five years.

ACCORDING to the *Lancet*, it has been decided by the Liverpool School of Tropical Medicine to establish a permanent laboratory in Sierra Leone for the purpose of carrying on research work. It is hoped that the laboratory will act as a base from which expeditions to other regions of tropical Africa may be dispatched from time to time.

AN International Conference of Telegraph Engineers is to be held in Berne from September 14 to 20 next. Among the subjects open for discussion are the prospects of telephony over longer distances, the protection of telegraph and telephone wires from other electrical conductors, and how far automatic apparatus in telephone exchange working is desirable.

THE summer meeting of the Institution of Naval Architects will be held in Newcastle-on-Tyne on July 7–10, at the invitation of the institution by the president and council of the North-East Coast Institution of Engineers and Shipbuilders. Meetings for the reading of papers will be held, and arrangements will be made to visit some of the principal works in Newcastle and its vicinity.

IN order to commemorate the work of Wilbur Wright, who, with his brother, Orville Wright, evolved the first successful power-driven aeroplane, the Wilbur Wright Memorial Fund was created under the auspices of the Aeronautical Society for the purpose of providing for the annual delivery of a premium lecture. The second memorial lecture will be delivered by Dr. R. T. Glazebrook, director of the National Physical Laboratory, on May 20, at the Royal United Service Institution, Whitehall, S.W. The Right Hon. Lord Sydenham will preside.

MR. A. N. HALL has been appointed Government curator of the Ancient Monuments of Rhodesia. According to the *Geographical Journal*, the objects under his charge will include not only ruins, but all relics wherever found, and also the Bushman paintings, all of which are in future to be protected from vandalism and preventible destruction. The headquarters of the curator will be at Great Zimbabwe, but Mr. Hall hopes, it is stated, to spend four months of each year in examining or searching for other remains.

THE Board of Agriculture and Fisheries desires to bring to the attention of the public the arrangement now established at the Royal Botanic Gardens, Kew, whereby a competent guide accompanies visitors on weekdays through the gardens and explains the many objects of botanical interest. A small charge is made for the services of the guide, 6*d.* for each person attending a morning tour, and 3*d.* for each person attending an afternoon tour. The present arrangements are of the nature of an experiment, and their continuance beyond September next will depend on the extent of the public demand for the services of the guide. A leaflet giving detailed information on the subject can be obtained on application to the director, Royal Botanic Gardens, Kew.

THE thirteenth annual general meeting of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society on April 29, Sir E. Ray Lankester, president of the association, being in the chair. Dr. P. Chalmers Mitchell and Mr. F. A. Potts were elected to fill two vacancies on the council. In the annual report reference was made to the discovery at Plymouth of the puerulus stage of the sea crayfish (Palinurus) by Prof. Bouvier, of Paris, to the investigations on eggs and young stages of British food fishes, by Mr. R. S. Clark, on the feeding habits and rate of growth of invertebrates, by Mr. J. H. Orton, and on the culture of plankton diatoms, by Dr. E. J. Allen. Mention was also made of work carried out at the laboratory by Mrs. Matthews on the development of Alcyonium, by Dr. Mortensen on the larvæ of Echinoderms, by Dr. Shearer, Mr. De Morgan, and Mr. Fuchs on the hybridisation of Echinoderms, by Mr. J. Gray on the electrical conductivity of Echinus eggs, and by Dr. Stuart Thomson on the brain of Elasmobranchs. It was reported that Mr. D. J. Matthews and Mr. L. R. Crawshay had returned to the laboratory from the expedition of the *Scotia* to the coast of Labrador, and Mr. E. W. Nelson from the British Antarctic Expedition, and that these gentlemen had been employed in working up the material which they had obtained.

AT Greenwich the mean temperature for the month of April was 50·8°, which is 2·7° above the average. This is the warmest April for the last ten years, but there have been six warmer Aprils since 1841, the warmest being 53·9° in 1865. The mean of the maximum temperatures was 61·1°, and the mean of the minimum 40·5°. There were three days with a temperature of 70° or above; in 1865 there were fourteen days above 70°. The total rainfall was 1·12 in., of which 1·10 in. was measured during the first ten days and only 0·02 in. at Greenwich in the remainder of the month. The duration of sunshine at Greenwich was 231·6 hours, which is 166 per cent. of the average. It is the sunniest month at any time of the year since the memorable summer of 1911, and has only once been surpassed previously in April at Greenwich, 1909 having 250 hours of bright sunshine. There were thirteen days with more than ten hours of sunshine, and April 30 was the only day during the month on which the sun did not shine.

IN the recent annual report of the Decimal Association there is a reference to the legalisation of the metric carat in this country. Although the Order in Council came into operation so recently as April 1, it is satisfactory to note that the adoption of the new unit by dealers in diamonds and precious stones is already practically complete, and has occasioned little or no inconvenience. The manufacturers of weights in this country do not appear to have realised that the change would be effected so readily, and in consequence of this a large proportion of the sets of metric carat weights have been imported from the Continent to meet the sudden demand. The largest metric carat weight legalised is the 500 C.M., which is equivalent to 100 grams. Many diamond dealers who have been accustomed to use weights up to 5000 carats were inclined at first to imagine that such large single weights would not be permissible in future, but they now understand that above 500 C.M. the ordinary metric series, 200 grams, 500 grams, kilogram, etc., may be employed, and little difficulty is experienced by them in adapting their operations to the new conditions.

THE Peabody Museum of American Archæology and Ethnology, Harvard University, publishes a fine monograph by Mr. A. M. Tozzer on the prehistoric ruins of Nakum, in Guatemala. The museum expeditions since 1888 have been engaged in exploring the Maya area in Mexico, Guatemala, Honduras, and British Honduras. Unfortunately, these interesting ruins have suffered much from fires lighted by natives to clear the ground for cultivation, and from sheer vandalism. Quite recently some of the sculptured stelæ at Copan were destroyed to make the foundations for an adobe wall. Several ruined cities have been discovered, and it is well that the surveys now in progress should be undertaken while the material remains undisturbed.

THE *Times* of April 25 publishes a preliminary report on the excavations at the Great Stone Circle at Avebury. The work has extended to the silting of the fosse on the east side, and against the solid chalk entrance causeway on the south of the great circle. A few antler picks and hammers and a finely worked flint implement have already been found in the chalk rubble, and in the Roman stratum nearer the surface a ring and part of a bracelet, both of bronze. In the cutting of the vallum have been decovered two red deer antlers and an interesting bone pin nicely worked and polished. The old surface line has been reached in places, and is clearly defined; on it have been found several small fragments of prehistoric pottery, a flint scraper, and two flint saws, as well as clear traces of charcoal.

ACCORDING to the April number of the *Museums Journal*, the chief loan collections at the twenty-fifth conference of the Museum Association, to be held at Swansea in July, will comprise Welsh pottery and porcelain, paintings by old masters and modern Rouen artists, Rouen decorative metal-work, and old Welsh furniture and lacquer.

AMONG questions discussed in Publication No. 2169 (Opinions 52–56) of the International Commission on Zoological Nomenclature is the validity of the names, which were edited by Linnæus, in Hasselquist's "Iter Palæstinum"—published prior to 1757. It is ruled that these are invalid, despite the publication of a German translation of the volume in 1757, which, it had been urged, might justify their recognition.

THE surface-swimming copepod crustaceans of the Gulf of Manaar form the subject of the longest article, by Capt. R. B. S. Sewell, in No. 35 (vol. ix.) of *Spolia Zeylanica*. The account is mainly based on two collections—one made between 1906 and 1909 inclusive, and the other in 1913; these embrace a total of eighty-seven species and subspecies, of which five are described as new. This number also includes the second part of a paper by Dr. J. Pearson on the holothurians of the Indian Ocean, together with a revision, by the same writer, of the genera Muelleria and Holothuria.

IN the introduction to a long reply on certain criticisms of the theory of mimicry, the greater portion of which appears in the January issue of the Proceedings of the Academy of Philadelphia, Prof. Poulton remarks that more definite evidence than we at present possess with regard to the butterfly-eating habit in birds, and that some species of butterflies are nauseous to them, is urgently required. Such evidence is, however, steadily increasing, an important item coming from Uganda, where a wagtail, after eating butterflies belonging to two groups, rejected one representing a third.

"ELVERS," writes Mr. J. S. Elliott in an article on eels and eel-catching in Bedfordshire in the April number of the *Zoologist*, ascend the Ouse and its tributaries in swarms from the Wash. From the time of Domesday Book most Bedfordshire mills have been provided with eel-traps, which in early days furnished a considerable instalment of the rent. Although apparently less than formerly, the total average catch in the county is now about 3 tons 18 cwt., representing something like 17,500 eels, with a value, at the local price of 6*d*. a pound, of practically 220*l*.

To the March number of *Naturen* Mr. Orjan Olsen contributes an illustrated account of the whales of South Africa, and whaling as carried on at Durban and Saldanha Bay on the east, and at Port Alexandre, Benguela, on the west coast. A considerale amount of space is devoted to *Balaenoptera brydei*, the new rorqual described by Mr. Olsen last year, of which 169 individuals were taken in 1912. In the following year, up to July, 92 common fin-whales and 36 blue whales were captured at the Saldanha Bay station. The other species taken were the southern humpback (*Megaptera boöps*, or *nodosa, lalandei*), the southern right whale (*Balaena australis*), which is very rare, and the sperm-whale.

PHOTOGRAPHS of two recently added animal groups appear in the report of the American Museum of Natural History, one representing the reptile life of the Californian cactus-desert tract, and the other showing portions of two piles grown over with mussels and sea-anemones from a group illustrating the fauna of submerged timber. An item in the report well worthy the attention of museum curators in this country is a photograph of fireproof cases recently installed for the storage of mammal skins. If this is worth doing in America, it is still more so in our our own Natural History Museum, with its priceless series of "type" specimens. Even if the new method of storage could not be applied to the whole study-collection, it might be employed for types.

DR. ENRICO FESTA has utilised the opportunity presented by the Italian occupation of Rhodes to visit the island for the purpose of studying its fauna. An account of his observations, and reports on his collections have recently been published (*Bolletino dei Musei di Zoologia ed Anat. comp. della R. Università di Torino*, vols. xxviii.–xxix). Most of the animals recorded belong to species already known from other parts of the Mediterranean region, but a few are new or of special interest. A hundred and thirteen species of birds were obtained, including a new species of jay (Garrulus) and a new species of redbreast (Erithacus). There are two new earthworms (Helodrilus), two new woodlice (Armadillidium), three new locustids, one of which is referred to a new genus, and a new variety of the river crab (*Potamon edule*) of southern Europe. The other groups reported upon are the hymenoptera, fleas, earwigs, scorpions, and the mosses and liverworts (these last in *Annali di Botanica*, vol. xii.).

AN account of work on the control of damping-off disease in plant beds has been recently published in bulletin form (No. 31, University of Wisconsin Agricultural Experiment Station). According to the observations of the author, Mr. James Johnson, the two most common fungi giving rise to the disease are Pythium de Baryianum and Rhizoctonia, and these have been found on seedlings of a large number of different plants, including cress, tobacco, lettuce, tomato, etc. The effect of various cultural conditions, such as moisture, temperature, aeration on the growth and spread of the disease, is discussed, and the results of experiments as to preventive measures are given.

Treatment of infected soils with formalin 1 : 50 has been found efficient in checking the disease, but from the point of cheapness and efficiency steam-heating is recommended. Certain secondary effects, such as the killing of weed seeds and the destruction of insect pests in the soil, and greatly increased size and vigour of plants grown in treated soils, were also noted.

In a recent Bulletin of the U.S. Weather Bureau the Rev. M. Saderra Masó describes an interesting series of earthquakes which occurred in the sub-province of Benguet (Luzon) in August and September, 1913. They were very numerous (about 350 occurring in little more than a month), as a rule of slight intensity, and, even with the strongest, of very small disturbed area. It is probable that they originated at a very slight depth. As the earthquakes occurred at the close of the rainy season, in a limestone district in which the annual rainfall is about 160 inches, and in which there are frequent subsidences of the ground, the author concludes that the earthquakes are neither tectonic nor volcanic in their origin, but probably due to underground rock-falls and secondary faults.

The Meteorological Office of Canada has recently issued an interesting monograph, "Canadian Weather Forecasting," as an addendum to "Gales from the Great Lakes to the Maritime Provinces," covering the years 1905–12, prepared by Mr. B. C. Webber, under the superintendence of the director of the Meteorological Service. In a preceding monograph for the period 1874–1904 Mr. Webber suggested some aids to assist the forecast officials, and these have now been supplemented, and the tables show, in addition, the percentages of low-pressure areas causing storms in various months and districts and the directions in which the depressions moved, together with other useful information. November is the most stormy month on the Great Lakes during the season of navigation, but January and February are the stormiest in the Gulf of St. Lawrence and the Maritime Provinces; March is not an unusually stormy month. Within the eight years in question the area of the Canadian weather map has been much enlarged, and knowledge of movements of high- and low-pressure areas has been enhanced by the introduction of a daily meteorological chart of the northern hemisphere since January 1, 1912. It is, however, reluctantly admitted that the advancement of weather forecasting has been more or less disappointing. The author considers that the study of the upper air and of solar physics will eventually undoubtedly assist in solving some of the vexed problems which confront the meteorologist.

The necessity of bringing modern mathematical concepts within the range of study of comparatively elementary students has led Mr. C. Elliott, of King Edward VII. School, Sheffield, to produce a book of 116 pages, entitled "Models to Illustrate the Foundations of Mathematics" (Edinburgh: Lindsay and Co., 1914, price 2*s.* 6*d.*). It consists of four chapters dealing respectively with the meaning of correspondences, multiplexes, spaces defined as ordered multiplexes, correspondence of operands to functions, and multiple correspondence. Although a selection of classificatory models was exhibited at the 1912 Mathematical Congress, the use of the term "models" in the title of this book may perhaps be rather misleading, for it consists mainly of definitions and explanations, and the nearest approach to models generally consists in mere references to illustrations of classes, like and unlike things, correspondences, and so forth, where these can be exemplified by objects of everyday life. The question as to how far the subject can be understood and appreciated by schoolboys is a very interesting one.

The first of a series of illustrated articles descriptive of a 300,000-h.p. hydro-electric plant on the Mississippi appears in the *Engineer* for May 1. These works are situated at Keokuk, on the Iowa side of the river, about 130 miles north of the mouth of the Missouri River, and 137 miles from the city of St. Louis. One purpose of the power development is to deliver current in large quantities to distant points by transmission lines up to 200 miles in length, and in August last the supply of current to St. Louis was commenced. The electric light and tramway company of St. Louis has contracted to take 60,000 h.p. for a term of ninety-nine years. The works comprise three main sections. First, a dam 4700 ft. long, extending from the east bank at Hamilton to within a thousand feet of the west bank at Keokuk. Secondly, a power-house, extending downstream from the end of the dam for a length of 1700 ft. Thirdly, a dam extending from the lower end of the power-house to the west bank, forming the fore-bay and having a large single-lift lock for navigation. The total length of monolithic concrete construction is more than two miles. The working head of water available for the machines ranges from 23 to 40 ft.

OUR ASTRONOMICAL COLUMN.

May Meteors.—It is hoped that favourable conditions will be experienced for the observation of Coronid meteors in May. Mr. W. F. Denning directs attention to this shower in *Astronomische Nachrichten*, No. 4726. In recent years he found the chief radiant point to be about $246^\circ + 30^\circ$ near ζ Coronæ, and a few degrees west of ρ Herculis. According to his observations in 1903 and 1911, the meteors were white, swift, and usually trainless. The most suitable time for their observation is between May 18 and 26, and the absence of the moon will render the observation more easy.

Comet 1914*a* (Kritzinger).—The following is the continuation of the ephemeris of comet 1914*a* (Kritzinger) which was given in this column last week, the information being gathered from Prof. H. Kobold's communication to the *Astronomische Nachrichten*. No. 4729:—

12*h.* *M.T.* *Berlin.*

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
May 7	18 46 9	+23 29·0	
8	50 57	24 25·9	8·5
9	55 45	25 21·9	
10	19 0 34	26 16·7	
11	5 24	27 10·4	
12	10 14	28 2·8	8·4
13	15 4	28 53·9	
14	19 19 54	+29 43·6	

The comet is situated near the boundaries of the four constellations, Hercules, Vulpes, Cygnus, and Lyra.

A CONVENIENT COMPARISON SPECTRUM.—For the study of both terrestrial and celestial spectra, it is useful for many purposes to photograph a comparison spectrum alongside the spectrum under investigation. The spectrum of iron is most generally used as the lines are well distrubuted along the spectrum, are sharp, and their wave-lengths are accurately determined. The iron, however, may not be pure, so several strange lines may appear in the spectrum, and these have to be investigated. Dr. Joseph Lunt, in searching for a convenient means of obtaining the spectrum of cyanogen has incidentally found that the spectrum of lead pencils gives an extremely fine set of lines, very sharp, well distributed along the spectrum, exhibits a remarkable constancy of spectroscopic composition, and consists of lines which are almost without exception present in the solar spectrum, the wave-lengths of which have been well determined. The account of this investigation on the spectra of graphites and lead pencils is given in vol. x. of the Annals of the Cape Observatory, part iv., and should be read by all those who work with the spectroscope. A plate reproduces the lead pencil spectrum from λ 4071·91 to λ4742·98. The sharp metallic lines are for the most part due to iron, titanium, vanadium, chromium, and the alkaline earths, barium, strontium, and calcium, while the spectrum shows also the presence of the rarer elements, gallium, scandium, and yttrium, as well as silicon, magnesium, and manganese. The carrier of a lead pencil thus possesses a small portion of the very rare elements gallium and scandium.

REPORT OF HARVARD COLLEGE OBSERVATORY.—The report of the director of the Astronomical Observatory of Harvard College for the year ending September, 1913, gives one a good idea of the great field of work projected and of the large amount of work accomplished during the past months. It is hoped that means will be found to concede to the director's wishes stated in this report by increasing the income of the observatory, for the situation is not very satisfactory when, as Prof. Pickering states, "during the last twenty years the income of the University has more than doubled, while that of the observatory has diminished rather than increased." The report shows, in the first instance, the progress made in the Henry Draper memorial department, the revised Draper Catalogue being the principal work. More than half the sky has been covered, and 100,155 stellar spectra have already been classified. The 11-in. Draper telescope, in the hands of Prof. W. H. Pickering, has produced valuable results, among which may be mentioned the periodic changes in form of the discs of Jupiter's satellites. The work of the Boyden department at the Arequipa Station, of the Blue Hill Meteorological department (recently transferred to Harvard University), etc., are all briefly summarised, and indicate the wide range of activities.

THE SCHILOWSKY GYROSCOPIC TWO-WHEELED MOTOR-CAR.

A LARGE two-wheeled motor-car, constructed from the design of Dr. Schilowsky, a Russian Doctor of Laws, by the Wolseley Tool and Motor Company, Ltd., was given a trial run in London last week. The car is a six-seated car, and it carried six people as it slowly made a circuit of Regent's Park. The gyroscopic mechanism is placed in the cupboard under the middle four seats. This consists of a heavy gyrostat rotating at the moderate speed of 1100 revolutions a minute, and driven by an electric motor of $1\frac{1}{2}$ horse-power. The axis is vertical, and it is mounted in a ring supported on transverse trunnions, so that it may tilt in a fore and aft plane. As the car is necessarily unstable on its two wheels, the gyrostatic ring must also be carried unstably for it to have corrective influence. If, as a ship, the car could have been carried stably, then the gyrostatic ring would also have to be stably mounted. If one is stable and the other unstable then the gyrostat operates in the opposite sense to that intended.

The unstably mounted gyrostat will not maintain the car in its upright position for long, as the precessional oscillations increase in amplitude. Dr. Schilowsky counteracts this by an ingenious piece of mechanism. Driven by worm-gearing from the gyrostat axle are two spur wheels, each just out of gear with a segmental rack, but capable of being brought into gear by a heavy pendulum which feels any tilting of the car away from the dynamical vertical. This is only allowed to engage at such times as the gyrostat ring is approaching the neutral position. During this time the engagement causes a hurrying of the precession and a consequent steadying of the motion. At the moment the neutral position is reached the pinion and rack are disconnected by a snap mechanism reminding one of that used for closing the valves of a Corliss engine. One pendulum controls the engagement when the gyrostatic ring is approaching the neutral position from one side, while the other effects the control on the other side of the neutral position. Either alone might be used, but the two alternate with one another and maintain a more continuous control. It is a curious fact that the controlling mechanism is more easily adjusted so as to maintain the equilibrium of the car when it is turning in the opposite direction to the rotation of the wheel. For turning in the same direction more exact adjustment is necessary. A working model railway on this system has been presented by Dr. Schilowsky to the South Kensington Museum, where it may be seen by anyone interested.

The car weighed three tons, having been designed for running on a rail, while the engine was one of the maker's standard 16-h.p. engines. This was insufficient in power to drive the heavy car, as well as the motor of the flywheel, more than about four miles an hour. At this speed and at rest or moving backwards the car maintained its position with passengers jumping on or off. When a new load was applied to one side the car moved almost imperceptibly so as to raise it and maintain the centre of gravity over the line of support as has already been made familiar by Mr. Brennan with his monorail.

It will be interesting to see how the car behaves when a more powerful engine is fitted and higher speeds are possible. The inventor is, of course, aware of the very great couple, ordinarily resisted by the four-wheel support of the motor-car when ordinary curves and speeds are negotiated together, which he will have to contend with in like circumstances. The demonstration in the Regent's Park did not show that the gyrostatic control then existing would be sufficient for this, but it did show, and that perfectly, that the first step has been successfully accomplished. It may be worth while to add that the bicycle balance is not used, the gyrostatic control being independent of speed or direction of motion.

C. V. BOYS.

RELATIONS BETWEEN THE SPECTRA AND OTHER CHARACTERISTICS OF THE STARS.*

II.

Brightness and Spectral Class.

HAVING thus made a rapid survey of the general field, I shall now ask your attention in greater detail to certain relations which have been the more special objects of my study.

Let us begin with the relations between the spectra and the real brightness of the stars. These have been discussed by many investigators—notably by Kapteyn and Hertzsprung—and many of the facts which will be brought before you are not new; but the observational material here presented is, I believe, much more extensive than has hitherto been assembled. We can only determine the real brightness of a star when we know its distance; but the recent accumulation of direct measures of parallax, and the discovery of several moving clusters of stars the distances of which can be determined, put at our disposal far more extensive data than were available a few years ago.

Fig. 1 shows graphically the results derived from all the direct measures of parallax available in the spring of 1913 (when the diagram was constructed). The spectral class appears as the horizontal coordinate, while the vertical one is the absolute magnitude, according to Kapteyn's definition—that is, the visual magnitude which each star would appear to have if it should be brought up to a standard distance, corresponding to a parallax of 0·1″ (no account being taken of any possible absorption of light in space). The absolute magnitude, −5, at the top of the diagram, corresponds to a luminosity 7500 times that of the sun, the absolute magnitude of which is 4·7. The absolute magnitude 14, at the bottom, corresponds to 1/5000 of the sun's luminosity. The larger dots denote the stars for which the computed probable error of the parallax is less than 42 per cent. of the parallax itself, so that the probable error of the resulting absolute magnitude is less than ±1·0m. This is a fairly tolerant criterion for a "good parallax," and the small dots, representing the results derived from the poor parallaxes, should scarcely be used as a basis for any argument. The solid black dots represent stars the parallaxes of which depend on the mean of two or more determinations; the open circles, those observed but once. In the latter case, only the results of those observers whose work appears to be nearly free from systematic error have been included, and in all cases the observed parallaxes have been corrected for the probable mean parallax of the comparison stars to which they were referred. The large open circles in the upper part of the diagram represent mean results for numerous bright stars of small proper-motion (about 120 altogether) the observed parallaxes of which scarcely exceed their probable errors. In this case the best thing to do is to take means of the observed parallaxes and magnitudes for suitable groups of stars, and then calculate the absolute magnitudes of the typical stars thus defined. These will not exactly

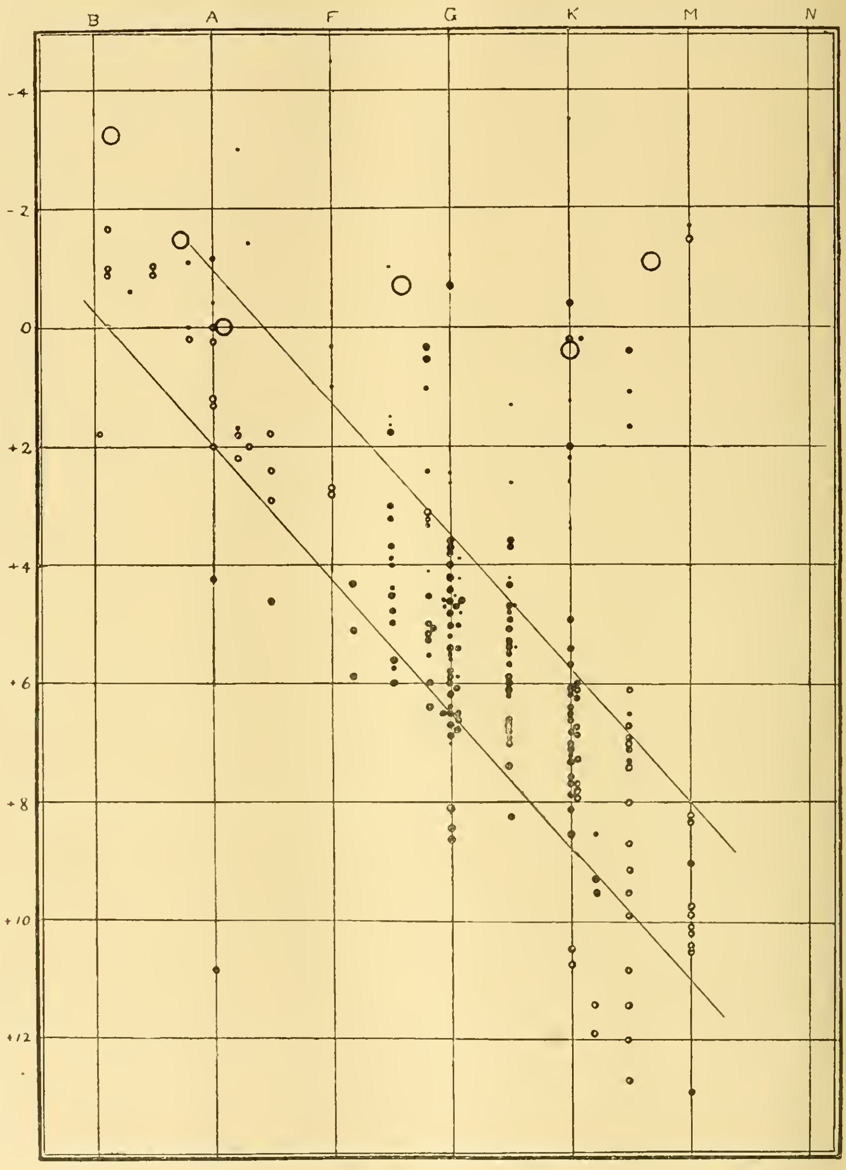


FIG. 1.

* An address delivered before a joint meeting of the Astronomical and Astrophysical Society of America and Section A of the American Association for the Advancement of Science, at Atlanta, Georgia, December 30, 1913, with a few additions, by Prof. H. N. Russell. Continued from p. 230.

correspond to the mean of the individual absolute magnitudes which we could obtain if we knew all the parallaxes exactly, but they are pretty certainly good enough for our purpose.

Upon studying Fig. 1 several things can be observed.

(1) All the white stars, of Classes B and A, are bright, far exceeding the sun; and all the very faint stars—for example, those less than 1/50 as bright as the sun—are red, and of Classes K and M. We may make this statement more specific by saying, as Hertzsprung does,[16] that there is a certain limit of brightness for each spectral class, below which stars of this class are very rare, if they occur at all. Our diagram shows that this limit varies by rather more than two magnitudes from class to class. The single apparent exception is the faint double companion to O_2 Eridani, concerning the parallax and brightness of which there can be no doubt, but the spectrum of which, though apparently of Class A, is rendered very difficult of observation by the proximity of its far brighter primary.

(2) On the other hand, there are many red stars of great brightness, such as Arcturus, Aldebaran, and Antares, and these are as bright, on the average, as the stars of Class A, though probably fainter than those of Class B. Direct measures of parallax are unsuited to furnish even an estimate of the upper limit of brightness to which these stars attain, but it is clear that some stars of all the principal classes must be very bright. The range of actual brightness among the stars of each spectral class therefore increases steadily with increasing redness.

(3) But it is further noteworthy that all the stars of Classes K5 and M which appear on our diagram are either very bright or very faint; there are none comparable with the sun in brightness. We must be very careful here not to be misled by the results of the methods of selection employed by observers of stellar parallax. They have for the most part observed either the stars which appear brightest to the naked eye, or stars of large proper-motion. In the first case, the method of selection gives an enormous preference to stars of great luminosity, and, in the second, to the nearest and most rapidly moving stars, without much regard to their actual brightness. It is not surprising, therefore, that the stars picked out in the first way (and represented by the large circles in Fig. 1) should be much brighter than those picked out by the second method (and represented by the smaller dots). But if we consider the lower half of the diagram alone, in which all the stars have been picked out for proper-motion, we find that there are no very faint stars of Class G, and no relatively bright ones of Class M. As these stars were selected for observation entirely without consideration of their spectra (most of which were then unknown) it seems clear that this difference at least is real, and that there is a real lack of red stars comparable in brightness with the sun, relatively to the number of those 100 times fainter.

The appearance of Fig. 1 therefore suggests the hypothesis that, if we could put on it some thousands of stars instead of the 300 now available, and plot their absolute magnitudes without uncertainty arising from observational error, we would find the points representing them clustered principally close to two lines, one descending sharply along the diagonal, from B to M, the other starting also at B, but running almost horizontally. The individual points, though thickest near the diagonal lines, would scatter above and below it to a vertical distance corresponding to at least two magnitudes, and similarly would be thickest near the horizontal line, but scatter above and below it to a distance which cannot so far be definitely specified, so that there would be two fairly broad bands in which most of the points lay. For Classes A and F these two zones would overlap, while their outliers would still intermingle in Class G, and probably even in Class K. There would, however, be left a triangular space between the two zones, at the right-hand edge of the diagram, where very few (if any) points appeared, and the lower left-hand corner would be still more nearly vacant.

We may express this hypothesis in another form by saying that there are two great classes of stars, one of great brightness (averaging, perhaps, a hundred times as bright as the sun), and varying very little in brightness from one class of spectrum to another; the other of smaller brightness, which falls off very rapidly with increasing redness. These two classes of stars were first noticed by Hertzsprung,[17] who has applied to them the excellent names of *giant* and *dwarf* stars. The two groups, on account of the considerable internal differences in each, are only distinctly separated among the stars of Class K or redder. In Class F they are partially, and in Class A thoroughly, intermingled, while the stars of Class B may be regarded equally well as belonging to either series.

In addition to the stars of directly measured parallax, represented in Fig. 1, we know with high accuracy the distances and real brightness of about 150 stars which are members of the four moving clusters the convergent points of which are known, namely, the Hyades, the Ursa Major group, the 61 Cygni group, and the large group in Scorpius, discovered independently by Kapteyn, Eddington, and Benjamin Boss, the motion of which appears to be almost entirely parallactic. The data for the stars of these four groups are plotted in Fig. 2, on the same system as in Fig. 1. The solid black dots denote the members of the Hyades; the open circles, those of the group in Scorpius; the crosses, the Ursa Major group; and the triangles, the 61 Cygni group. Our lists of the members of each group are probably very nearly complete down to a certain limiting (visual) magnitude, but fail at this point, owing to lack of knowledge regarding the proper motions of the fainter stars. The apparently abrupt termination of the Hyades near the absolute magnitude 7·0, and of the Scorpius group at 1·5, arises from this observational limitation.

The large circles and crosses in the upper part of Fig. 2 represent the absolute magnitudes calculated from the mean parallaxes and magnitudes of the groups of stars investigated by Kapteyn, Campbell, and Boss, concerning which data were given in Table III. The larger circles represent Boss's results, the smaller circles Kapteyn's, and the large crosses Campbell's.

It is evident that the conclusions previously drawn from Fig. 1 are completely corroborated by these new and independent data. Most of the members of these clusters are dwarf stars, and it deserves particular notice that the stars of different clusters, which are presumably of different origin, are similar in absolute magnitude. But there are also a few giant stars, epecially of Class K (among which are the well-known bright stars of this type in the Hyades); and most remarkable of all is Antares, which, though of Class M, shares the proper motion and radial velocity of the adjacent stars of Class B, and is the brightest star in the group, giving out about two thousand times the light of the sun.

16 *A. N.*, 4422, 1910.

17 *Zeitschrift für Wissenschaftliche Photographie*, vol. iii., p. 442, 1905.

It is also clear that the naked-eye stars, studied by Boss, Campbell, and Kapteyn, are, for the most part, giants. With this in mind, we are now in a position to explain more fully the differences between the results of these investigators.

All the stars of Class B are giants, and, so far as we may judge from the Scorpius cluster, they do not differ from one another very greatly in absolute brightness. It is therefore natural that the results of all three investigators are in this case fairly similar, though Campbell, in employing stars that averaged brighter to the eye than did the others, has evidently been working with stars that are really brighter. In Class A the giants and dwarfs differ so little, and are so thoroughly intermingled, that the situation is about the same. In Class M, even the nearest and brightest of the dwarf stars are invisible to the naked eye: hence the stars of this class studied by the three investigators are all giants, and once more their results agree.

A number of the dwarf stars of Class K are visible to the naked eye; but these all lie very near us, and have such large proper motions that they are excluded as "abnormal" by both Campbell and Boss. The results of the two agree in indicating that the stars studied by them are typical giants. The few dwarfs, however, have such large parallaxes and proper-motions that their inclusion more than doubles the mean proper-motion, and presumably, also, the mean parallax of the whole, as shown by Kapteyn's figures in Table III. For Class G, the dwarf stars average much brighter, and a much greater number of them is visible to the naked eye. These have large parallaxes and proper-motions, and raise the average for all the stars of this class to greater values than for any other. But Boss's rigorous limitation to small proper-motions weeds them practically all out, leaving giant stars once more. Campbell's less drastic procedure omits only the nearer of the dwarfs (to be precise, those with the larger proper-motions), and his result lies about half-way between the others. In the case of Class F, the dwarf stars are still brighter—intermingling, in fact, with the giants. We can therefore see them farther off, and we get more of them in our catalogues, in proportion to the giants, than in any other class. Their mean parallax is, however, smaller than for the dwarfs of Classes G and K, and hence the mean proper-motion and parallax of all the stars of this class is less than for Class G. Campbell's criterion here excludes very few stars, and even Boss's admits a good many of the remoter and slower moving dwarfs, causing his mean parallax and proper-motion to be considerably greater for this class than for any other.

It should finally be added that Kapteyn's discussion shows that the stars of Class N are exceedingly bright, possibly surpassing any of the other giant stars.

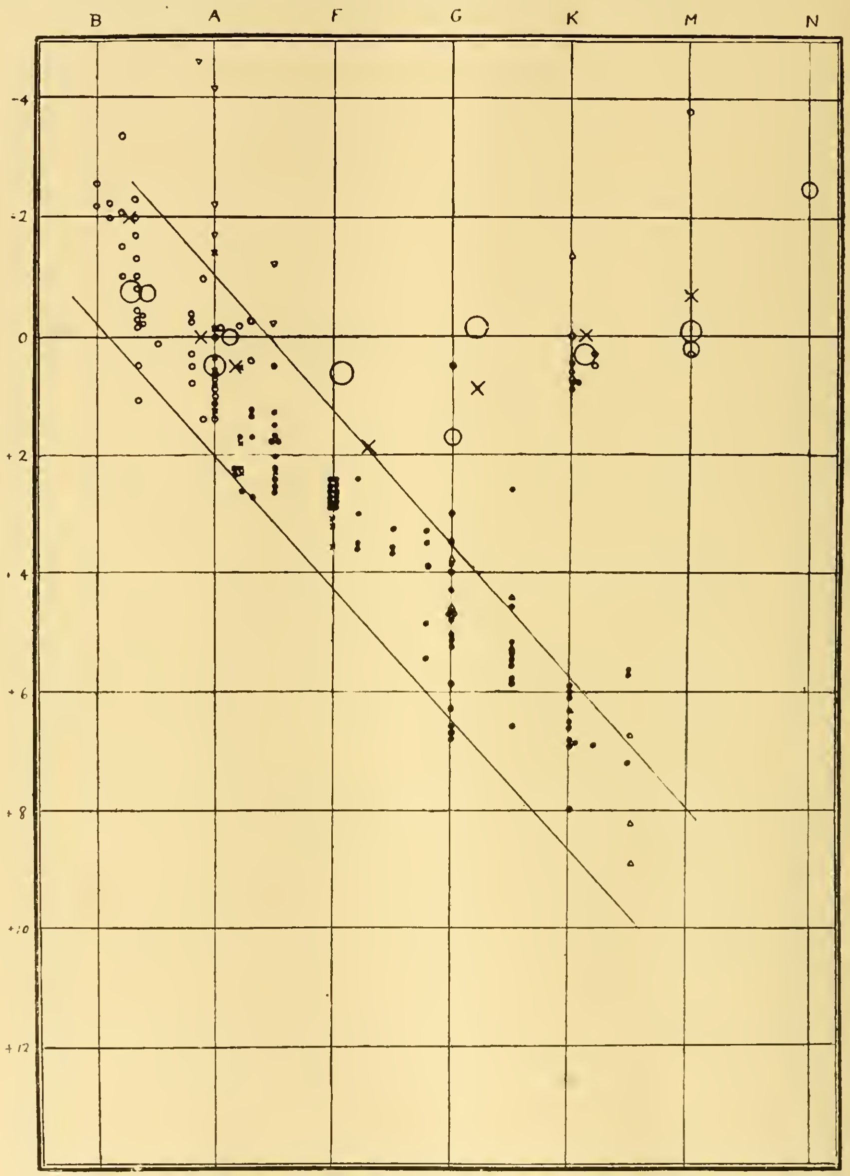


Fig. 2.

We are now in a position to define more precisely the brightness of a typical giant or dwarf star of a given class of spectrum, and also to obtain a measure of the degree of divergence of the individual stars from this typical brightness. Taking first the stars of Class B and the dwarf stars of the other classes, we find, for the mean absolute magnitudes of all the stars of each class, the following values :—

TABLE V.
Mean Absolute Magnitudes.

Spectrum	Stars of measured parallax No.	Abs. mag.	Formula	O–C	Stars in clusters No.	Abs. mag.	Formula	O–C
				m.				m.
B2	—	—	—	—	21	−1·2	−1·1	−0·1
B8	—	—	—	—	8	+0·3	+0·2	+0·1
A0	6	+1·4	+1.4	0·0	13	0·5	0·6	−0·1
A4	7	2·5	2·3	+0·2	26	1·7	1·5	+0·2
F0	—	—	—	—	15	2·4	2·7	−0·3
F1	5	4·2	3·7	+0·5	—	—	—	—
F3	—	—	—	—	7	3·3	3·3	0·0
F5	9	4·3	4·5	−0·2	—	—	—	—
F8	8	5·1	5·2	−0·1	5	4·2	4·4	−0·2
G0	29	5·7	5·6	+0·1	18	5·0	4·8	+0·2
G5	19	5·7	6·6	−0·9	9	5·1	5·8	−0·7
K0	28	7·1	7·7	−0·6	9	6·4	6·9	−0·5
K4	19	9·2	8·6	+0·6	7	+7·0	+7·7	(−0·7)
Ma	10	+9·9	+9·8	+0·1	—	—	—	—

The rate of decrease of brightness with increasing redness is very nearly the same for the stars with directly measured parallaxes and the stars in clusters, but the latter appear, with remarkable consistency, to be about 0·8m. brighter than the former. This seems at first sight very puzzling, but it is undoubtedly due to the way in which the stars observed for parallax were selected. Most observers, in preparing their working lists, have included mainly those stars which were brighter than a given magnitude and had proper-motions exceeding some definite limit. Of the stars above this limiting magnitude, those of greater actual luminosity will be, on the average, farther away, and have smaller proper-motions, than those of small luminosity, and selection by proper-motion favours the latter. The limitation of our present lists to stars the parallaxes of which have been determined with a probable error not exceeding 42 per cent. of their own amounts, though necessary to diminish the effects of casual errors of observation, works in the same direction, for, among the stars of any given visual magnitude, those of greatest luminosity have the smallest parallaxes, and are least likely to pass the test. The difference shown in our table need not therefore alarm us, but it is clear that the stars in clusters, rather than the others, should be taken as typical of the dwarf stars as a whole. For both sets of stars the absolute magnitude appears to be very nearly a linear function of the spectral class (if B is regarded as 1, A as 2, etc.) The columns headed "formula" in Table V. give the values calculated from the expressions M = 1·4m. + 2·1m. (Sp. − A) for the stars of directly measured parallax, and M = 0·6m. + 2·1m. (Sp. − A) for the stars in clusters. The residuals from these empirical formulæ, for the mean absolute magnitudes of the observed stars of different classes, average ±0·33m. in the first case and ±0·29m. in the second. They appear to be accidental in character, though in some cases (notably in Class G5) the residuals for the stars of the two sets are similar in sign and magnitude. The large negative residuals for Classes K and K5 in the clusters arise from the fact that in the Hyades, which contribute most of these stars, only the brighter ones have had their proper-motions determined, and get into our lists, as is clear from examination of Fig. 2.

Among the dwarf stars, therefore, a typical star of any spectral class is about seven times fainter than one of the preceding class, and seven times brighter than one of the following class.

The giant stars of all the spectral classes appear to be of about the same mean brightness, averaging a little above absolute magnitude zero, that is, about a hundred times as bright as the sun. Since the stars of this series which appear in Fig. 2 have been selected by apparent brightness, which gives a strong preference to those of the greatest luminosity, the average brightness of all the giant stars in a given region of space must be less than this, perhaps considerably so.

By tabulating the residual differences between the absolute magnitudes of the individual dwarf stars and the values given by the formulæ just described, we find that the average difference, regardless of sign, for the stars of measured parallax is ±0·88m. for spectra A to F8, ±1·02m. for spectra G and G5, and ±1·15m. for K and M. For the stars in clusters, the average differences are ±0·70m. for spectra B0 to B9, ±0·66m. for A and A5, ±0·56m. for spectra F to F8, and ±0·80m. for G and G5.

These differences are larger for the stars of measured parallax than for the others (probably on account of the greater average uncertainty of the individual parallaxes and spectra in this case), but show no marked systematic variation with the class of spectrum. Their distribution follows very approximately the law of accidental errors, as is shown by Table VI., in which the observed numbers lying between certain limits are compared with those given by this law

TABLE VI.
Distribution of Differences from the Typical Absolute Magnitudes.

Stars with measured parallax Limits	Observed	Theory	Stars in clusters Limits	Observed	Theory
m. m.			m. m.		
±0·0 to ±0·8	65	61	±0·0 to ±0·5	59	58
±0·8 to ±1·6	41	44	±0·5 to ±1·0	42	42
±1·6 to ±2·4	21	23	±1·0 to ±1·5	21	24
±2·4 to ±3·2	10	9	±1·5 to ±2·0	10	8
±3·2 to ±4·0	3	3	±2·0 to ±2·5	4	4

The theoretical distribution for the stars in clusters corresponds to a probable error of ±0·61m., and that for the others to one of ±0·94m. Correction for the known influence of uncertainties of the parallaxes and spectra would reduce the latter to about ±0·75m. It appears, therefore, that the absolute magnitude of a dwarf star can be predicted with surprising accuracy from a mere knowledge of its spectrum. Half of all the dwarf stars are not more than twice as bright or as faint as the typical stars of their spectral classes. The corresponding uncertainty in the estimated parallax would be about one-third of its amount.

The parallaxes of the giant stars are so small, in comparison with the errors of even the best present methods of observation, that direct observations are not well adapted to determine to what degree they differ in brightness among themselves. An indirect method of determining this is, however, practicable, among those classes in which all the naked-eye stars are giants, by comparing the parallactic motions of those stars the proper-motions of which at right angles to the direction of the parallactic drift are large and small. A discussion by this method of the typical case of Class M (the details of which will be given elsewhere) shows that, if the distribution of the absolute magnitudes of these stars also follows the "law of errors," the probable error corresponding to it is approximately ±0·6m.—almost exactly the same as has already been found for the dwarf stars. The mean absolute magnitude of all the stars of this class which are visible to the naked eye is −0·5, and that of all the stars in a given region of space is +0·6. This method can scarcely be applied to the naked-eye stars of the other spectral classes (unless some way can be devised for weeding out the dwarf stars from among the giants); but it seems probable that they do not differ greatly from the stars of Classes B and M as regards the degree of their similarity to one another in brightness With such a probable error of distribution of the absolute magnitudes as has here been derived, the giant and dwarf stars would overlap perceptibly in Class G, be just separated in Class K, and widely so in Class M, as the observational data indicate.

The questions now arise: What differences in their nature or constitution give rise to the differences in brightness between the giant and dwarf stars? and Why should these differences show such a systematic increase with increasing redness or "advancing" spectral type?

We must evidently attack the first of these questions before the second. The absolute magnitude (or the actual luminosity) of a star may be expressed as a function of three physically independent quantities—its mass, its density, and its surface-brightness. Great mass, small density, and high surface-brightness make for high luminosity, and the giant stars must possess at least one of these characteristics in a marked degree, while the dwarf stars must show one or more of the opposite attributes.

A good deal of information is available concerning all these characteristics of the stars. The masses of a considerable number of visual and spectroscopic binaries are known with tolerable accuracy, the densities of a larger number of eclipsing variable stars have recently been worked out, and the recent investigations on stellar temperatures lead directly to estimates of the relative surface brightness of the different spectral classes (subject, of course, to the uncertainty whether the stars really radiate like black bodies, as they are assumed to do). We will take these matters up in order.

First, as regards the masses of the stars, we are confined to the study of binary systems, which may or may not be similar in mass to the other stars. There appears, however, to be no present evidence at all that they are different from the other stars, and in what follows we will assume them to be typical of the stars as a whole.

The most conspicuous thing about those stellar masses which have been determined with any approach to accuracy is their remarkable similarity. While the range in the known luminosities of the stars exceeds a millionfold, and that in the well-determined densities is nearly as great, the range in the masses so far investigated is only about fiftyfold. The greatest known masses are those of the components of the spectroscopic binary and eclipsing variable V Puppis, which equal nineteen times that of the sun; the smallest masses concerning which we have any trustworthy knowledge belong to the faint components of ζ Herculis and Procyon, and are from one-third to one-fourth of the sun's mass. These are exceptional values, and the components of most binary systems are more nearly similar to the sun in mass.

There appears, from the rather scanty evidence at present available, to be some correlation between mass and luminosity. Those stars which are known to be of small mass (say, less than half the sun's) are all considerably fainter than the sun. On the other hand, Ludendorff[18] has shown conclusively that the average mass of the spectroscopic binaries of spectrum B (which are all of very great luminosity) is three times as great as that of the spectroscopic binaries of other spectral types, and may exceed ten times that of the sun. Further evidence in favour of this view is found in the fact that the components of a binary, when equal in brightness, are nearly equal in mass, while in unequal pairs the brighter star is almost (if not quite) always the more massive, but the ratio of the masses very rarely exceeds 3 : 1, even when one component is hundreds of times as bright as the other. Very large masses (such as one hundred times the sun's mass) do not appear, though they would certainly be detected among the spectroscopic binaries if they existed. It is equally remarkable that there is no trustworthy evidence that any visible star has a mass as small as one-tenth that of the sun. The apparent exceptions which may be found in the literature of the subject may be shown to arise from faulty determinations of parallax, arbitrary estimates of quantities unobtainable by observation (such as the ratio of the densities of the two components of Algol), and even numerical mistakes.

[18] *A. N.*, 4520, 1911.

It follows from this similarity of mass that we can obtain a very fair estimate of the parallax of any visual binary (called by Doberck the hypothetical parallax) by guessing at its mass, and reversing the familiar relation between mass and parallax. If we assume that the mass of the system is twice that of the sun (about the average value), our hypothetical parallaxes, as the existing evidence shows, will usually be well within 40 per cent. of the truth, and the deduced absolute magnitudes of the components will rarely be more than one magnitude in error. We may thus extend our study of the relation between absolute magnitude and spectrum to all the visual binaries for which orbits have been computed. The hypothetical absolute magnitudes which we will obtain for them will indeed be somewhat in error, owing to the differences in their masses; but, for our present purpose, *the hypothetical values are actually more useful than the true values would be.* This sounds remarkable; but it is easy to show that, if we assume that the brighter components of the systems have all the same mass (say that of the sun), the resulting hypothetical absolute magnitudes will be the actual absolute magnitudes of stars identical in density and surface-brightness with the real stars, but all of the assumed mass. In other words, *the effects of differences of mass among the stars are eliminated from these hypothetical absolute magnitudes,* leaving only those of differences in density and surface-brightness. (This is simply a statement in different form of a theorem which has been known for many years.) It is therefore desirable to extend our study to as many binary stars as possible. The number for which binary orbits have been computed is relatively small, but by a simple statistical process we may include all those pairs which are known to be connected really physically, however slow their relative motion may be.[19]

Consider any pair of stars, of combined mass m times that of the sun, at a distance of r astronomical units, and with a relative velocity of v astronomical units per annum. By gravitational theory, we have

$$v^2r=(2\pi)^2m(2-r/a)=39{\cdot}7m(2-r/a),$$

where a is the semi-major axis of the orbit Now let π be the parallax of the system, s the observed distance in seconds of arc, w the observed relative motion in seconds of arc per annum, and i_1 and i_2 the angles which r and v make with the line of sight. Then $s=r\pi\sin i_1$, $w=v\pi\sin i_2$, and our equation becomes

$$sw^2=39{\cdot}7\pi^3m\sin i_1\sin^2 i_2(2-r/a).$$

In the individual case, the last three factors of the second member are unknown, and we are no wiser

[19] An outline of this method was given by the speaker at the meeting of the Astronomical and Astrophysical Society of America at Ottawa, August 25, 1911, and published in *Science*, N.S., vol. xxxiv., pp. 523–25, October 20, 1911. A similar method was worked out quite independently and almost simultaneously by Hertzsprung, and published in *A. N.*, December 19, 1911 (the date of writing being October 11, 1911).

than at the start; but the average value which their product should have, in a large number of cases, and the percentage of these cases in which it should lie within any given limits, may be computed on the principles of geometrical probability. It is thus found that the formula $\pi^3 = sw^2/14{\cdot}6m$ gives values for the hypothetical parallax the average for a large number of cases of which will be correct, and that, while in individual cases these values will be too large or too small, half of them will be within 19 per cent. of the true values, and the numbers of larger errors will fall off in very nearly the manner corresponding to this probable error. If we compute absolute magnitudes from these parallaxes, their average for all the stars will be a little too bright (since the cases in which the computed parallax comes out too small have more influence than those in which it is too large). This may be allowed for by adding 0·15m. to all the hypothetical magnitudes so computed—an amount almost negligibly small for our present purpose.

We thus obtain a series of hypothetical absolute magnitudes the average for a large number of cases of which will be correct. In 59 per cent. of the individual cases the error arising from the statistical process—that is, from the substitution of a mean value of

$$\sin i_1 \sin^2 i_2 (2 - r/a)$$

for the true value—will affect the deduced magnitude by less than $\pm 0{\cdot}5$m., and in 89 per cent. of all cases the error will not exceed $\pm 1{\cdot}0$m. The approximation is therefore quite sufficient for our purpose. It should, however, be noted that, while the error of the statistical process can never make the computed absolute magnitude of any star too faint by more than 1·5m., it may in rare cases make it too bright by any amount whatever—more than 2·0m. in one case in sixty, more than 3·0m. once in 250 cases, and so on.

We may now proceed to compute hypothetical absolute magnitudes for all the physical pairs which show even a trace of relative motion—including many which are ordinarily described as "fixed," but, on careful study of the observations, show very slow relative change. With the aid of the splendid collection of observational data contained in Burnham's great catalogue and other recent works on double stars, and of many observations of spectra made at Harvard in generous response to requests for information, it has been possible to derive results for more than 550 stars. Assuming that the brighter component of each of these (which is usually the only one of which the spectrum is known) is equal in mass to the sun, estimating that of the fainter component on the basis of the difference of brightness (with the data for the systems in which the mass-ratio is known as a sufficient guide), and proceeding as indicated above, we obtain the data plotted in Fig. 3. The co-ordinates have here the same meaning as in the previous diagrams, and the figure shows at a glance the relations which would exist between the absolute magnitudes and spectra of these 550 stars if all differences of mass were eliminated, leaving only those of density and surface-brightness operative. Binaries for which orbits have been computed are shown by solid dots, and physical pairs, to which the statistical process has been applied, by open circles.

FIG. 3

Our new diagram is strikingly similar in appearance to the previous ones, even in its minor details.

The two series of giant and dwarf stars appear once more; the giants are all of about the same brightness, except that those of Class B are brighter than the rest; the dwarf stars diminish in brightness by about two magnitudes for each spectral class; the two series overlap up to Class G and separate at Class K, and so on. We have clearly come, for the third time, and again from independent data, upon the same phenomena as before; and, with the more extensive observational material, some of the characteristics and relations of the two groups are shown better than ever.

But this new evidence does much more than to confirm that which we have previously considered—it proves that the distinction between the giant and dwarf stars, and the relations between their brightness and spectral types, do not arise (primarily at least) from differences in mass. Even when reduced to equal masses, the giant stars of Class K are about one hundred times as bright as the dwarf stars of similar spectrum, and for Class M the corresponding ratio is fully 1000. Stars belonging to the two series must therefore differ greatly either in surface brightness or in density, if not in both.

There is good physical reason for believing that stars of similar spectrum and colour-index are at least approximately similar in surface brightness, and that the surface brightness falls off rapidly with increasing redness. Indeed, if the stars radiate like black bodies, the relative surface brightness of any two stars should be obtainable by multiplying their relative colour-index by a constant (which is the ratio of the mean effective photographic wave-length to the difference of the mean effective visual and photographic wave-lengths, and lies usually between 3 and 4, its exact value depending upon the systems of visual and photographic magnitude adopted as standards). Such a variation of surface brightness with redness will evidently explain at least the greater part of the change in absolute magnitude among the dwarf stars (as Hertzsprung and others have pointed out), but it makes the problem of the giant stars seem at first sight all the more puzzling.

The solution is, however, very simple. If a giant star of Class K, for example, is one hundred times as bright as a dwarf star of the same mass and spectrum, and is equal to it in surface brightness, it must be of ten times the diameter and 1/1000 of the density of the dwarf star. If, as in Class M, the giant star is one thousand times as bright as the dwarf, it must be less than 1/30,000 as dense as the latter. Among the giant stars in general, the diminishing surface brightness of the redder stars must be compensated for by increasing diameter, and therefore by rapidly decreasing density (since all the stars considered have been reduced to equal mass).

But all this rests on an assumption which, though physically very probable, cannot yet be said to be proved; and its consequences play havoc with certain generally accepted ideas. We will surely be asked, Is the assumption of the existence of stars of such low density a reasonable or probable one? Is there any other evidence that the density of a star of Class G or K may be much less than that of the stars of Classes B and A? Can any other evidence than that derived from the laws of radiation be produced in favour of the rapid decrease of surface brightness with increasing redness?

We can give at once one piece of evidence bearing on the last question. The twelve dwarf stars of Classes K2 to M, shown in Fig. 3, have, when reduced to the sun's mass, a mean absolute magnitude of 7·8—three magnitudes fainter than the sun. If of the sun's surface brightness, they would have to be, on the average, of one-fourth its radius, and their mean density would be sixty-four times that of the sun, or ninety times that of water—which is altogether incredible. A body of the sun's mass and surface brightness, even if as dense as platinum, would only be two magnitudes fainter than the sun, and the excess of faintness of these stars beyond this limit can only be reasonably ascribed to deficiency in surface brightness. For the four stars of spectra K8 and M, the mean absolute magnitude of which, reduced to the sun's mass, is 9·5, the mean surface brightness can at most be one-tenth that of the sun.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The office of superintendent of the museum of zoology will shortly become vacant by the resignation of Dr. Doncaster. The stipend at present attached to the office is 200*l.* per annum.

Applications to occupy the University's table in the Zoological Station at Naples, and that in the laboratory of the Marine Biological Association at Plymouth should be addressed to Prof. Langley, The Museums, Cambridge, on or before June 4.

Mr. C. G. Darwin, eldest son of the late Sir George Darwin, has been appointed mathematical lecturer at Christ's College.

Glasgow.—It is announced that honorary degrees are to be conferred on Dr. Archibald Barr, late regius professor of civil engineering and mechanics in the University, Colonel Sir William B. Leishman, F.R.S., professor of pathology in the Royal Army Medical College, and Sir Ernest H. Shackleton, C.V.O. The degrees will be conferred on Commemoration Day, June 23, when an oration on Lord Lister will be delivered by Sir Hector C. Cameron.

London.—The Page-May Memorial Lectures for the current session will be delivered by Dr. Keith Lucas, whose subject will be "The Conduction of the Nervous Impulse." The course will be held at University College, on Fridays, beginning on May 15. The lectures are open to all internal students of the University of London and to such other persons as are specially admitted. Applications should be addressed to the secretary, University College, London (Gower Street, W.C.).

Oxford.—Congregation on May 5 passed a statute authorising the establishment of an additional professorship in chemistry, to be called Dr. Lee's Professorship of Chemistry. In the same Congregation the statutes providing for the establishment of Dr. Lee's Professorships of Anatomy and Experimental Philosophy, in place of the existing Lee's Readerships, passed their first stage. Should these statutes be finally approved, the University will be relieved of its present contribution of 1470*l.* towards the stipends of the professors of human anatomy and experimental philosophy, and will gain an additional professor of chemistry, the consequent charges being borne in all these cases by Christ Church.

The Halley Lecture for 1914 will be delivered by Colonel C. F. Close, director of the Ordnance Survey, at the Examination Schools at 8.30 p.m. on May 20. Subject, "The Geodesy of the United Kingdom."

The celebration of the seven hundredth anniversary of the birth of Roger Bacon will be held on Wednesday, June 10.

Brown University, Rhode Island, is to receive a visit in November next from Prof. W. H. Bragg, of Leeds University, who will deliver a course of four lectures on "X-Rays and Crystals."

DR. R. S. ROGERS, a graduate of Edinburgh University, has been appointed lecturer on forensic medicine in the University of Adelaide, and Dr. Swift succeeds Dr. W. T. Hayward as lecturer on clinical medicine in the same University.

THE committee of Livingstone College have decided to appoint Dr. L. E. Wigram to succeed Dr. C. F. Harford as principal of Livingstone College when the latter resigns his post at the end of July. Dr. Wigram was educated at Harrow School, Trinity College, Cambridge, and St. Thomas's Hospital, and he is a graduate in medicine and arts of the University of Cambridge. He was formerly a medical missionary at Peshawar, on the north-west frontier of India, under the Church Missionary Society.

IN the House of Commons on Monday, the Chancellor of the Exchequer explained his Budget proposals. The education grant is to be reconstituted on the principle of making a distinction between the richer and the poorer areas, and between the areas that spend much and those that spend little on education. The increased cost to the Exchequer of the education grant will be 2,750,000*l.*, but this year the grant will be confined to the necessitous school areas. The Government is to contribute one-half of the cost of the feeding of hungry school children, and also to make grants for physical training, open-air schools, maternity centres, and technical, secondary, and higher education. Referring to these grants, Mr. Lloyd George said:—"The grants for technical, secondary, and higher education are to make it more accessible to the masses of the children, and to extend its sphere of influence where children show any aptitude to take advantage of it. We compare very unfavourably with Germany and the United States of America in this respect. There there is adequate provision for technical training, secondary and higher training for every child who shows any special gift for taking advantage of it, and I consider that this fact is a greater menace to our trade than any arrangements of tariffs. We propose that there should be a very substantial grant for this purpose which will include a grant for pensions for secondary-school teachers in order to attract the best men to that most important profession. There will be a grant for the special training of teachers already in schools in subjects specially appropriate to rural areas, manual instruction, cookery, physical exercise, and commercial subjects. The total cost for the first year will be 560,000*l.* for these grants, and 282,000*l.* for the other grants which I mentioned. That will be for the first full year, and will be for England and Wales." There will be a special grant of 750,000*l.* for public health purposes in connection with tuberculosis, nursing, and pathological laboratories. Upon the subject of laboratories, Mr. Lloyd George said:—"Another deficiency has been exposed in our health service by the operation of the Insurance Act. There is no provision for the scientific diagnosis of disease. In Germany, in almost every town, and I think in France, you have pathological laboratories which are of enormous assistance to doctors in ascertaining the real character of a disease when they are in any doubt upon the subject. There are a few boroughs in the United Kingdom where something has been done—even in London—but we propose to make a grant for the purpose of aiding the local authorities to set up these laboratories throughout the United Kingdom."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 30.—Sir William Crookes, O.M., president, in the chair.—Prof. B. **Moore**: The presence of inorganic iron compounds in the chloroplasts of the green cells of plants, considered in relationship to natural photo-synthesis and the origin of life.—Dr. J. C. **Willis**: The lack of adaptation in the Tristichaceæ and Podostemaceæ.—R. P. **Gregory**: The genetics of tetraploid plants in *Primula sinensis*. The paper describes results of experiments with two giant races of *Primula sinensis*, which have been shown to be in the tetraploid condition—that is, the plants have $4x$ (48) chromosomes in the somatic cells and $2x$ (24) chromosomes in the gametic cells, whereas in the ordinary (diploid) races of the species the numbers are $2x$ (24) and x (12) respectively. The result of most general interest is the discovery that reduplication of chromosomes has been accompanied by reduplication of series of factors, so that, whereas in the diploid zygote each factor is represented twice, AA; in the tetraploid zygote it is represented four times, AAAA; and there are three distinct hybrid types, namely, AAAa, AAaa, and Aaaa. The reduplication is made manifest by the occurrence of F_2 ratios in the form 15D : 1R, when in the diploid races the ratio is 3D : 1R. This result recalls those obtained by Nilsson-Ehle in oats and wheat, and by East in maize, but in the tetraploid Primulas the reduplication affects not merely the factors for isolated characters, but all the factors which it has been possible to study.—J. A. **Gunn**: The action of certain drugs on the isolated human uterus. It has been found that the involuntary contractile tissues (such as the heart, intestine, and uterus) of *mammals* can be kept exsected in Locke's solution at ordinary room temperatures for many hours, while still retaining the power of executing normal rhythmic movements when subsequently placed, under the proper conditions, in oxygenated Locke's solution at body temperature. With this knowledge, it is possible, without difficulty, to perform experiments on certain isolated human tissues, removed in the course of surgical operations; and those experiments can be made under similar conditions to, and therefore entirely comparable with, experiments made on corresponding tissues of those mammals ordinarily used for investigation. In this paper this method of investigation has first been utilised to determine the response of the isolated human uterus to certain drugs.—D. J. **Lloyd**: The influence of osmotic pressure upon the regeneration of *Gunda ulvae*. *G. ulvae* is capable of living indefinitely in water having an osmotic pressure of more than 2 and less than 33 atmospheres. The rate of regeneration of the posterior end in *G. ulvae* depends on the osmotic pressure of the medium. This osmotic pressure has an optimum value for regeneration at 18 atmospheres, *i.e.* just below that of sea-water, and limiting values at 5 and 33·5 atmospheres. Restoration of lost parts in *G. ulvae* is brought about entirely by the undifferentiated parenchyma cells which migrate to the region of the wound and build up the lost parts.—Surg.-Gen. Sir D. **Bruce**, Major A. E. **Hamerton**, Capt. D. P. **Watson**, and Lady **Bruce**: (*a*) *Glossina brevipalpis* as a carrier of trypanosome disease in Nyasaland. (*b*) Trypanosome diseases of domestic animals in Nyasaland. *Trypanosoma pecorum*. Part iii.—Development in *Glossina morsitans*.—H. E. **Armstrong** and H. W. **Gosney**: Studies on enzyme action. XXII.—Lipase. (IV.).—The correlation of synthetic and hydrolytic activity.

Zoological Society, April 21.—Dr. Henry Woodward, vice-president, in the chair.—Surgeon J. C. **Thompson**: Further contributions to the anatomy of the Ophidia.—Rev. T. R. R. **Stebbing**: Crustacea from the Falkland Islands. At intervals during a period of some fifteen years Mr. Rupert Vallentin has used prolonged opportunities for collecting, among other things, the crustacean fauna of the Falkland Islands. An initial report on this subject was made to the society in the year 1900. In January of the present year Dr. Thomas Scott, in the "Annals and Magazine of Natural History," has discussed some of the Copepoda. The contribution now offered has to do chiefly with the Malacostraca. Five new species are proposed.—J. S. **Huxley**: The courtship of the great crested grebe; with an addition to the theory of sexual selection.—S. **Hirst**: The Arachnida (other than spiders) and Myriopoda obtained by the British Ornithologists' Union and Wollaston Expeditions to Dutch New Guinea. The collection is only a small one, but contains two new species of Acari parasitic on mammals and three new species of millipedes. A new species of parasitic mite collected by Prof. F. Forster on various mammals in German New Guinea is also described.—Major J. Stevenson **Hamilton**: The coloration of the African hunting-dog (*Lycaon pictus*).—C. Tate **Regan**: Note on *Aristeus goldiei*, Macleay, and on some other fishes from New Guinea.—Miss A. **Carlsson**: Two species of fossil Carnivora, from the Phosphorites of Quercy, contained in the collections of the Zootomical Institute at Stockholm.

Challenger Society, April 29.—Prof. E. W. MacBride in the chair.—Prof. E. W. **MacBride**: Conditions of cross-fertilisation in the sea. The factors hindering crossing between different species of Echinoderms were discussed.—C. Tate **Regan**: The distribution of antarctic fishes. It was pointed out that the distribution of coast fishes south of the tropics calls for the recognition of three zones—south temperate, subantarctic, and antarctic. The subantarctic zone includes the Magellan and Antipodes districts; the antarctic zone the Glacial and Kerguelen districts. Nearly all the antarctic fishes are Nototheniiformes, and nearly all the genera and species are peculiar to the zone; in the subantarctic zone Nototheniiformes are present, but there is also a number of south temperate types.

Dublin.

Royal Irish Academy, April 27.—Rev. J. P. Mahaffy, president, in the chair.—Rev. Canon **Lett**: A census catalogue of the mosses of Ireland. Part i. This paper gives a short account of all deceased botanists who have paid any attention to the mosses of Ireland, together with a note of all known publications on the subject, from the Rev. John Ray, whose synopsis (1690) is the earliest work in which Irish mosses are mentioned, down to the present day. The list given by the writer contains the names of 636 mosses indigenous to Ireland, and with each is given the first known and the latest records, together with the date and name of the collection.—W. D. **Haigh**: The Carboniferous volcanoes of Philipstown, in King's County. This paper deals with the small volcanic district of Croghan Hill, north of Philipstown, in King's County. In an area of about four square miles a number of volcanic necks breaks through the Carboniferous Limestone. The ash is interbedded with the limestone at and above the cherty zone which separates the Lower from the Middle Limestone. The volcanic activity was thus contemporaneous with the major outbursts in the Limerick district. The latter portion of the paper deals with the petrography of the igneous rocks, which consist chiefly of dolerites and basalts passing into the more basic variety, limburgite. Glomero-porphyritic structure is a common feature of these intrusive rocks.—A. C. **Forbes**: Tree growth (in connection with the Clare Island Survey). Although no plant worthy of the name of tree now exists on Clare Island, abundance of scrub, consisting of oak, birch, mountain ash, holly, hazel, willow, etc., occurs on the east side of the island, suggesting that at no very distant date woodland was more or less general both over Clare Island and the adjacent islands and mainland. Tree remains in the bogs show that pine and birch were originally common on the lower parts of the island, followed at a later date by oak, which is found under mountain peat up to an altitude of 400 ft. The disappearance of this woodland was primarily due to a lowering of the summer temperatures, and an increase of wind off the sea, probably brought about by a higher sea-level in recent times. The original forest flora of the island undoubtedly dates back to a time when a connection with the mainland existed on the south-east, which was probably not interrupted until oak, hazel, and other species had established themselves, and suppressed or took the place of the pine of an earlier period. The most remarkable omissions from the present forest flora of the island are ash and elder, the latter being not only common on the mainland, but difficult to eradicate from grazed or uncultivated land.—G. P. **Farran**: Tunicata and Hemichorda (in connection with the Clare Island Survey). The paper summarised the published records of the group, together with some additional records added in the course of the Clare Island Survey.

Paris.

Academy of Sciences, April 27.—M. P. Appell in the chair.—The **President** announced the death of Prof. Suess, foreign associate.—H. **Deslandres**: Experimental research of a solar electrical field. Stark has recognised a new effect of the electric field on the light emitted by the canal rays; the bearing of the Stark effect on the study of the solar radiations is fully discussed.—Fred **Wallerant**: The mobility of the molecules in a solid crystal. A crystal of potassium nitrate is fused between two glass plates and allowed to solidify. It is now heated to a temperature well below its melting point, and slightly compressed by pressure at one point of the plate. New crystals appear which grow at the expense of the original crystal, and there is no relation between the orientations of the new and the old crystals. From this the author is led to modify his views on the polymorphism of camphor, which he now holds to be trimorphic and not quadrimorphic.—F. **Becke** was elected a correspondant for the section of mineralogy in the place of the late M. Rosenbusch.—Henri **Chrétien**: A mirror astrolabe. The prism of the ordinary instrument is replaced by two mirrors placed at an angle of 60°, one being fully silvered and the other half silvered. The arrangement possesses the following advantages: homocentricity of the two rays, increase of power of definition, possibility of constructing large astrolabes cheaply, and the suppression of the difficulties arising from the want of homogeneity of the glass of the prisms.—J. **Clairin**: Certain systems of partial differential equations of the second order with two independent variables.—W. **Blaschke**: New evaluation of distances in functional space.—Marcel **Riesz**: An interpolation formula for the differential of a trigonometrical polynomial.—Bertrand **Gambier**: The surfaces susceptible of being formed in several different ways by the displacement of an invariable curve.—Louis **Roy**: The motion in three dimensions of indefinite viscous media.—F. **Jager**: The application of the method of Ritz to certain problems of mathematical physics, and in particular to the tides.—Léon and Eugène **Bloch**: A new absorption spectrum of oxygen in the extreme ultra-violet. The absorption of air in the extreme ultra-violet commences at a wave-length of 1957, and is shown by a spectrum of regular bands, most probably belonging to oxygen. It is shown that these bands are due to absorption and not to fluorescence.—Thadée **Peczalski**: The differential scale of temperatures.—André **Léauté**: The propagation of surges along a heterogeneous electric line.—Jean **Perrin**: The osmotic compressibility of emulsions considered as fluids with visible molecules. In a previous communication it has been shown that the gas laws apply to dilute emulsions composed of particles of the same magnitude. In the present paper this conception is applied to strong emulsions, making use of Van der Waals equation.—René **Constantin**: The experimental study of the osmotic compressibility of emulsions. The experimental work of the preceding paper. The work was done with uniform spherical grains of radius 0·33 μ. Instantaneous photographs were taken of a column of emulsion 3 μ to 5 μ thick, with a horizontal microscope, sufficient time, three to four days, having been allowed for a state of equilibrium. Up to a certain concentration the fluid follows the law of Van der Waals, but above 2·4 per cent. the internal pressure diminishes, corresponding to a repulsive action between the grains.—A. **Portevin**: Re-heating and annealing after tempering of the alloys of copper and tin and copper and zinc.—Georges **Baume**: Remarks on the mechanism of the chemical reaction.—Auguste **Conduché**: The action of chloroform on metallic sulphates. Method of preparation of anhydrous chlorides. At temperatures above 300° C. chloroform vapour converts the sulphates of various metals into the anhydrous chloride. The reaction with copper sulphate at 300° C. gives pure cupric chloride; other metals require a higher temperature.—Georges **Tanret**: An alkaloid extracted from *Galega officinalis*. The alkaloid is called galigine, and has the composition $C_6H_{13}N_2$. The base is crystalline, and gives crystallised salts. M. **Picon**: The preparation of pure butine. Pure butine (ethylacetylene) has been prepared by the action of ethyl iodide upon sodium acetylide in liquid ammonia at a temperature of $-40°$ C. It was purified by fractional distillation, boils at 8·3°, and melts at $-137°$ C. Its density at 11° C. was found to be 2·47, as against 2·41 theoretical.—M. **Lespieau**: Some derivatives of octadiine-2 : 6-diol-1 : 8. The addition products with bromine, iodine, and hydrogen are described. Hydrogen in the presence of platinum black gives a mixture of the saturated glycol and primary octyl alcohol.—E. **Léger**: The optical isomerides of homonataloin and of nataloin and their reciprocal transformations.—J. L. **Vidal**: Cultural experiments on the vine.—Jacob **Eriksson**: Rust in the seeds of cereals.—R. **Marcille**: The nitrogenous materials of grape must. Both fixed organic nitrogen and volatile ammoniacal or amino-nitrogen are present in relative and absolute proportions which are extremely variable. The quantities are sufficient to ensure regularity in the fermentation.—E. **Maurel**: The influence of climate and season on food requirements. The amount of food required becomes less as the external temperature rises, on account of the smaller heat losses by the skin.—Etienne **Rabaud**: Researches on telegony. From experiments on mice the author is inclined to conclude that telegony is a purely imaginary phenomenon.—Fred **Vlès**: Remarks on the spectral structure of hæmoglobin substances. There are indications that the bands given by this class of substances can be represented by a series similar to that shown by Deslandres to hold for the nitrogen bands.—M. **Vasticar**: The internal auditive region of Corti's organ.—C. **Laurent**: Nervous accidents produced at a distance by projectiles used in war. A discussion of the possibility of nervous diseases being produced by shock without actual wounds by the projectile.—Gabriel **Bertrand**: Silver as a possible stimulant of growth in *Aspergillus niger*. In connection with the effects of traces of zinc and others metals on the growth of moulds, the theory of toxic stimulation has been put forward. Silver salts are known to exert a poisonous action on moulds, and experiments are here described to see if there is a critical concentration at which silver salts exert a stimulating effect on the growth. At no concentration was a stimulating effect observed, and the author contends that the theory of toxic stimulation is improbable.—M. **Javillier**: The utility of zinc for the growth of *Aspergillus niger*, cultivated in deep media. It has been alleged that when this mould is cultivated in deep instead of in shallow layers the favourable effect of zinc vanishes. Experiments are described by the author proving that this is not the case.—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis of the α-monoglucoside of glycol, by the aid of α-glucosidase. Starting with a solution of *d*-glucose, glycol, and an aqueous extract of low yeast, only the monoglucoside was obtained. Its purification and properties are given in detail.—Charles **Jacob** and Paul **Fallot**: The geology of Montsech, in Catalonia.—F. **Roman**: The Rhinocerídæ of the Mainz basin.

BOOKS RECEIVED.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second series. (Geology.) Vol i., No. 4. Vol. i., No. 5. (Sendai, Japan: Z. P. Maruya and Co., Ltd.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions. Vol. xx. Rapports. Pp. iv+228 Bulletin Statistique des Pêches Maritimes des Pays du Nord de l'Europe. Vol. vii. Pour l'Année 1910. (Copenhague: F. Host et Fils.)

New Zealand. Department of Mines. Geological Survey Branch. Bulletin No. 16 (new series). The Geology of the Aroka Subdivision, Hauraki, Auckland. By J. Henderson, assisted by J. A. Bartrum. Pp. vii+127+plates. (Wellington: J. Mackay.)

Canada. Department of Mines. Geological Survey Guide Books. No. 1 (two parts), Nos. 2, 3, 4, 5, 8 (three parts), 9 and 10. (Ottawa: Government Printing Bureau.)

The Principles of Inorganic Chemistry. By W. Ostwald. Translated by Prof. A. Findlay. Fourth edition. Pp. xxxiii+836. (London: Macmillan and Co., Ltd.) 18*s*. net.

Bulletin of the Argentine Meteorological Office. No. 2. First part. The Laws of the Evaporation of Water from Pans, Reservoirs and Lakes, Sand, Soils, and Plants. By Prof. F. H. Bigelow. Pp. 147. No. 3. The Thermodynamics of the Circulation and the Radiation of the Earth's Atmosphere. By Prof. F H. Bigelow. Pp. 106. (Buenos Aires.)

Elementary Theory of Equations. By Prof. L. E. Dickson. Pp. v+184. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

Cape Astrographic Zones. Vol i. Commenced under the direction of Sir David Gill. Completed and prepared for press under the supervision of S. S. Hough. Pp. li+430. (London: H.M.S.O.; Wyman and Sons, Ltd.) 15*s*.

Manual of the New Zealand Mollusca. By H. Suter. Pp. xxiii+1120. (Wellington, N.Z.: J. Mackay.)

Grosse Biologen. By Prof. W. May. Pp. vi+201+plates. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

Das Elisabeth Linné-Phänomen. By Prof. F. A. W. Thomas. Pp. 53. (Jena: G. Fischer.) 1.50 marks.

Field-Studies of Some Rarer British Birds. By J. Walpole-Bond. Pp. x+305. (London: Witherby and Co.) 7s. 6d. net.

Wild Flowers as They Grow, Photographed in Colour Direct from Nature. By H. E. Corke, with descriptive text by G. C. Nuttall. Seventh series. Pp. viii+204+plates. (London: Cassell and Co., Ltd.) 5s. net.

The English Year. Spring. By A. B. Thomas and A. K. Collett. Pp. ix+334+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10s. 6d. net.

People's Books:—Bacteriology. By Dr. W. E. C. Dickson. Pp. 95. Anglo-Catholicism. By A. E. M. Foster. Pp. 94. Robert Louis Stevenson. By R. Masson. Pp. 94. Canada. By F. Fairford. Pp. 94. Tolstoy. By L. Winstanley. Pp. 96. Greek Literature. By H. J. W. Tillyard. Pp. 92. (London and Edinburgh: T. C. and E. C. Jack.) 6d. net each.

Telegraphy. By the late Sir W. H. Preece. New edition. Revised and partly re-written by W. L. Preece. Pp. x+422. (London: Longmans and Co.) 7s. 6d. net.

Nucleic Acids. By Prof. W. Jones. Pp. viii+118. (London: Longmans and Co.) 3s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, May 7.

Royal Society, at 4.—Election of Fellows.—At 4.30.—(1) Some Calculations in Illustration of Fourier's Theorem; (2) The Theory of Long Waves and Bores: Lord Rayleigh.—Protection from Lightning and the Range of Protection afforded by Lightning Rods: Sir J. Larmor and J. S. B. Larmor.—Newcomb's Method of Investigating Periodicities and its Application to Brückner's Weather Cycle: Prof. A. Schuster.—The Flow in Metals subjected to Large Constant Stresses: E. N. da C. Andrade.—Eddy Motion in the Atmosphere: G. I. Taylor.—The Properties of Magnetically-shielded Iron as Affected by Temperature: Prof. E. Wilson.

Royal Institution, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R. Inge.

Royal Society of Arts, at 4.30.—The Punjab Canal Colonies: Sir J. M. Douie.

Child Study Society, at 7.30.—Education in Early Childhood before School-Age: Miss E. A. Parish and Dr. W. P. Sheppard.

Linnean Society, at 8.—The Botany of the Utakwa Expedition in Dutch New Guinea: H. N. Ridley and Others.—The Genus Lernæodiscus, F. Müller: G. Smith.—The Botanic Gardens at Sibpur (Calcutta), and the Government Cinchona Plantations: Major Gage.—A New Natural Order of Flowering Plants: Tristichaceæ: Dr. J. C. Willis.—The Forced or Cultural Production of Free, Spherical Pearls; a Preliminary Note on a New Method: J. Hornell.—Some Terrestrial Isopoda from New Zealand and Tasmania; with the Description of a New Genus, Notoniscus: Prof. C. Chilton.

FRIDAY, May 8.

Malacological Society, at 8.—Description of a New Helicoid from the Red Crag, Ramsholt: B. B. Woodward and A. S. Kennard.—The Radula of British Helicids. IV.: Rev. E. W. Bowell.—(1) Five New Species of Melania from Yunnan, Java, and the Tsushima Islands; (2) Description of a New Species of Strophocheilus, from Peru: H. C. Fulton.

Alchemical Society, at 8.15.—Some Mystical Aspects of Alchemy: Dr. E. Severn.

Physical Society, at 8.—A Graphic Treatment of the Rainbow and Cusped Wave-fronts: W. R. Bower.—Gyrostatic Devices for the Control of Moving Bodies: Dr. J. G. Gray.

Royal Astronomical Society, at 5.—Baxendell's Observations of Variable Stars, III: U Cygni, R Delphini, S Delphini, T Delphini. Edited by H. H. Turner and Mary A. Blagg.—The Resolution of a Compound Periodic Function into Simple Periodic Functions; J. B. Dale.—The Periodogram Analysis of the Variations of SS Cygni: D. Gibb.—A System of Photographic Magnitudes for Southern Stars: J. Halm.—Note on the Double Star OΣ 137: W. S. Franks.—*Probable Paper:* The Nebular Line λ3729: J. W. Nicholson.

SATURDAY, May 9.

Royal Institution, at 3.—Bird Migration: Prof. C. J. Patten.

MONDAY, May 11.

Royal Geographical Society, at 8.30.—The Condition and Prospects of the Panama Canal: Dr. Vaughan Cornish.

Royal Society of Arts, at 8.—Some Recent Developments in the Ceramic Industry: W. Burton.

Society of Engineers, at 7.30.—Notes on the Water Supply of Greater New York: W. T. Taylor.

Royal Institution, at 3.—The Last Chapter of Greek Philosophy: Plotinus as Philosopher, Religious Teacher and Mystic: The Very Rev. W. R. Inge.

TUESDAY, May 12.

Royal Institution, at 3.—The Present State of Evolutionary Theory Prof. W. Bateson.

Royal Society of Arts, at 4.30.—The Singing of Songs: Old and New I.: Folk Songs: H. Plunket Greene.

Royal Anthropological Institute, at 8.15.—Colour Blindness and Race: Dr. W. H. R. Rivers.—Standing Stones and Stone Circles in Yorkshire: A. L. Lewis.

WEDNESDAY, May 13.

Royal Society of Arts, at 8.—Glass Painting in Medieval and Renaissance Times: J. A. Knowles.

Geological Society, at 8.—The Scandinavian Drift of the Durham Coast, and the General Glaciology of South-East Durham: C. T. Trechmann.—The Relationship of the Vredefort Granite to the Witwatersrand System: F. W. Penny.

THURSDAY, May 14.

Royal Society, at 4.30.—*Probable Papers:* The Various Inclinations of the Electrical Axis of the Human Heart. Ia.: The Normal Heart. Effects of Respiration: Dr. A. D. Waller.—Fossil Plants showing Structure from the Base of the Waverley Shale of Kentcky: Dr. D. H. Scott and Prof. E. C. Jeffrey.—The Controlling Influence of Carbon Dioxide in the Maturation, Dormancy, and Germination of Seeds. II.: Franklin Kidd.—The Cultivation of Human Tumour Tissue *in vitro:* D. Thomson and G. J. Thomson.—The Nutritive Conditions Determining the Growth of Certain Freshwater and Soil Protista: H. G. Thornton and G. Smith.

Royal Institution, at 3.—Identity of Laws in General and Biological Chemistry: Prof. Svante Arrhenius.

Concrete Institute, at 7.30.—Sand and Coarse Material and Proportioning Concrete: J. A. Davenport and Prof. S. W. Perrott.

Society of Dyers and Colourists, at 8.—Notes on the Chemistry of Starch and its Transformations: W. A Davis.—The Analysis of Malt Extracts: W. P. Dreaper.—Temperature and Concentration as Affecting Hydration and Soda Absorption during the Process of Formation of Cellulose Monofils: Clayton Beadle and H. P. Stevens.

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THURSDAY, MAY 14, 1914.

RECENT EXTENSIONS OF THE QUANTUM HYPOTHESIS.

Die Theorie der Strahlung und der Quanten. Mit einem Anhange über die Entwicklung der Quantentheorie vom Herbst 1911 *bis zum Sommer* 1913. Edited by A. Eucken. Pp. xii + 405. (Halle a. S.: Wilhelm Knapp, 1914.) Price 18.60 marks.

A SHORT account was given in NATURE in November, 1911, of a meeting of the principal authorities on radiation questions held in the autumn of that year in Brussels, under the auspices of M. Ernest Solvay. The present work is the German edition of the papers read at that congress, together with the discussions which took place on them. In the course of the last two years the subject has developed very considerably, and the opinions expressed at Brussels would only give a very incomplete view of the present state of the theory, but this defect has been corrected by the editor, Prof. Eucken, who provides at the end of the book a fairly detailed sketch of the chief advances up to the summer of 1913.

This section provides extraordinarily interesting reading. Though no solution has yet been found of the central problem, several new phenomena have been brought under the quantum *régime*, and the position of the theory of specific heats under that *régime* has been completely altered. The older theory of Einstein and Nernst (an account of which is given in the earlier part of the book), supposed that every atom in a solid vibrates with a certain definite frequency, and so by the quantum principle can only take up energy in certain definite amounts. The resulting value for the specific heat agrees only very roughly with experiment at low temperatures. The new theory, developed independently by Debye and by Born and Kármán, applies the quantum principle not to the separate atoms, but to the elastic waves which can be propagated through the body. The agreement with experiment is very greatly improved, and there can be little doubt that the work provides the right basis for a theory, though the mathematical difficulties have so far prevented its being worked out completely. Debye's application of the quantum principle directly to waves instead of merely to vibrating electrons is one of the most important changes of aspect which have come over the subject. Since energy in a wave is not localised in one spot, the new aspect makes the physical comprehension of the quantum even harder than it was before, but in spite of this there is a gain in generality, and it should probably be counted as a distinct advance towards the final elucidation of the problem.

Another question which has become very prominent is "Nullpunktsenergie"—residual energy at the absolute zero of temperature. This first arose in connection with Planck's second radiation hypothesis, according to which a vibrating electron absorbs energy following the ordinary laws, but can only emit it when its total energy has reached one of a definite series of values. Thus near the absolute zero a vibrator may have quite a finite amount of energy, since it cannot emit at all the energy which it is slowly absorbing. According to a very important paper by Poincaré—almost his last published work—there is grave difficulty in accounting for the observed radiation formula in this way; but in spite of this the question of residual energy has been the subject of a good deal of discussion, and it has been invoked with some success though in a very speculative way, to account for several phenomena. In considering the evidence on these points Prof. Eucken concludes that each separate one might be explained in another way, but that the sum of all gives some probability in favour of the existence of residual energy at the absolute zero. According to a suggestion of Debye the reflection of X-rays may be made to throw light on this, since it may be possible to discover in what way the atoms of the reflecting crystal vibrate. So perhaps this important question may be decided soon.

The most striking development, to which Prof. Eucken refers, is the application of the quantum to the rotation of gas-molecules. Hitherto it had only met with success when applied to vibrations. In a rotating gas-molecule we have a periodic, but not a vibrational motion, and it must be of fundamental importance that the quantum applies to this. The most remarkable result of all is the work of Eva von Bahr, who finds that the absorption of infra-red light by water-vapour may be taken to indicate that the molecules are rotating only with multiples of two definite angular velocities. By the use of the quantum it is possible to calculate two moments of inertia for the molecule, and the values deduced are of the size which would be expected from its known dimensions. When further developed this work may be expected to throw light not only on the meaning of the quantum, but also on the structure of the molecule.

It is unfortunate that the book came out just too early to include a mention of Bohr's theory of spectra. This theory is very speculative, but unlike any of the previous theories it does give a simple reason for the observed series in spectra. Perhaps his most striking result is the theoretical evaluation of Balmer's constant with extraordinary closeness from Planck's constant and the electron constants. Bohr's work may prove very valuable in the solution of the central problem of the quantum; for it has the merit of carrying the principle of Planck, already hard to understand physically, logically to a very extreme point, and it is by the accentuation of difficulties that their solution is usually brought about.

It would be impossible within the limits of this notice to discuss the rest of the book adequately. It is sufficient to say that it deals with all the more firmly established developments in this branch of physics, and that the names of the writers are a guarantee of its value. C. G. D.

BOOKS ON PLANT DISEASES.

(1) *The British Rust Fungi.* By W. B. Grove. Pp. xii+412. (Cambridge: University Press, 1913.) Price 4*s*. net.

(2) *Mildews, Rusts, and Smuts.* By George Massee, assisted by Ivy Massee. Pp. 229+iv plates. (London: Dulau and Co., Ltd., 1913.) Price 7*s*. 6*d*. net.

(3) *The Fungi which Cause Plant Disease.* By Prof. F. L. Stevens. Pp. viii+754. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 17*s*. net.

(1) THE twenty-four years which have elapsed since Dr. Plowright published his classic monograph of the British Uredineæ and Ustilagineæ have seen great progress in our knowledge of the biology and classification of the former group—the rusts. Their heterœcism was a recognised fact; the life-history of *Puccinia graminis* was familiar to most botanical students, but the subject has broadened considerably in the last quarter of a century; *P. graminis* itself has been shown to include several species easily separable by form and colour; and, further, biological differences have been demonstrated, embodying a close adaptation between fungus and host, and the recognition of "physiological races." In this connection Mr. Grove utters his protest against the excessive multiplication of "species" by "biological" nomenclators:—"Physiological unaccompanied by morphological distinctions should never be allowed to constitute a difference of species, unless it be as a temporary measure in cases which have not been investigated." The difficulty arising in the case of heterœcious species from the existence of distinct names for the various phases of the same species has been overcome by the rule agreed to at the Brussels Congress to give preference to the earliest name given to the perfect (in this case the teleutospore) stage.

The book consists of a general and a systematic part. The former comprises a useful account of the variously complicated life-history of the Uredinales, *Puccinia caricis,* the nettle and sedge rust, a species more accessible to students than *P. graminis,* the aecidum stage of which is now rarely found in this country, is taken as a general type, but full accounts of other species are also given. A chapter on the sexuality of the group supplies a review of the work done in recent years by Blackman and others, and its important bearing on the systematic relationships and phylogeny of the group. A chapter on specialisation gives some account of the "biological races" above mentioned, and also severely criticises the mycoplasma theory of Eriksson. There is also a discussion of the phylogeny of the group and of the reasons for deriving it from the red algæ.

The systematic portion contains working descriptions of about 250 species, representing twenty-two genera and five families. The species in the larger genera, Uromyces (38 species) and Puccinia (137 species) are arranged in the order of the families and genera of their host-plants. An adequate synonymy is given, and the spores of a large proportion of the species are figured. At the end of the text are a short glossary, a bibliography, an index of host-plants, and a general index.

(2) In the small volume, "Mildews, Rusts, and Smuts," the author supplies in handy form a synopsis of the families Peronosporaceæ, Erysiphaceæ, Uredinaceæ, and Ustilaginaceæ in so far as the species have been met with in Britain as parasites on native or cultivated plants, or are likely to occur, in so far as they are parasitic on host-plants, indigenous to this country. Some of the latter, by the way, have already arrived. The many years which Mr. Massee has devoted to the study of British fungi should be a guarantee of value and of accuracy, and students of our native fungus-flora from an economic or purely scientific point of view will find the book a useful companion. Keys are given to the genera and species, and under each species there is an ample description and a list of host-plants. The numerous species of Puccinia are arranged under the orders and genera of the host-plant or one of the host-plants, a method which is sometimes misleading. Thus the well-known hollyhock fungus, for instance, will not be found under Althæa, but under Malva, and in the heterœcious species one host only is cited, that bearing the teleutospores. A coloured illustration of the life-history of *Puccinia graminis* makes an attractive frontispiece, and there are also four black and

white plates, mainly illustrating spore-forms at the end of the book.

(3) Dr. Stevens's book is a systematic descriptive account of the fungi which cause diseases of economic plants in the United States, and to some extent a companion volume to his "Diseases of Economic Plants," in which the effect of the disease on the host-plant and methods of prevention and cure are described. The term "fungi" is used in a broad sense, and includes myxomycetes and bacteria, as well as true fungi. Under the myxomycetes the author includes the parasitic plasmodiophorales; otherwise this group is a saprophytic one, and innocuous apart from occasional injury owing to the plasmodium overgrowing other plants. The chapter on bacterial disease is also a short one, and the great bulk of the volume deals with parasitic fungi. The arrangement is under the three classes: phycomycetes, ascomycetes, and basidiomycetes, followed by the fungi imperfecti. Under each class keys are given to the orders and families, and class, order and family are concisely described. A key to the genera follows the description of each family. Individual species are described at varying length according to their importance, and many which are not yet known in the United States are briefly mentioned, especially the more important, or those which are likely to invade America. There are text-illustrations of most of the species, and each section is followed by an extensive bibliography; there is also a good glossary at the end of the volume.

MECHANICAL AND CHEMICAL ENGINEERING.

(1) *The Principles of the Application of Power to Road Transport.* By H. E. Wimperis. Pp. xiv+130. (London: Constable and Co., Ltd., 1913.) Price 4*s.* 6*d.* net.

(2) *Farm Gas Engines.* By Prof. C. F. Hirshfeld and T. C. Ulbricht. Pp. vii+239. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 6*s.* 6*d.* net.

(3) *The Diesel or Slow-combustion Engine.* By Prof. G. James Wells and A. J. Wallis-Tayler. Pp. xvi+286. (London: Crosby Lockwood and Son, 1914.) Price 7*s.* 6*d.* net.

(4) *Cement, Concrete, and Bricks.* By Alfred B. Searle. Pp. xi+412. (London: Constable and Co., Ltd., 1913.) Price 10*s.* 6*d.* net.

(1) IN this work Mr. Wimperis has made available in an expanded form the substance of a series of lectures delivered in 1913 at the Finsbury Technical College on the application of power to road transport. In the chapter devoted to the measurement of power, the author describes fully the principles of construction, and the method of using the ingenious accelerometer, which he invented in 1909; by means of this instrument many measurements have now been made of the tractive effort exerted in moving motor-cars and wagons at various speeds, both on the level and on grades, and thus valuable experimental data have been accumulated as a basis for the design of motor vehicles. In a later chapter Mr. Wimperis shows by actual examples how the data obtained by such an instrument and from bench tests of engines may be utilised to design a motor vehicle from prescribed conditions; both motor wagons and touring cars are dealt with, and this chapter should prove of great assistance to designers of motor-cars.

In appendix ii. the author has reprinted the report on the brake horse-power tests carried out at Brooklands in July, 1912, and discusses the values obtained for the brake mean pressure, and the effects of air resistance. Mr. Wimperis has produced a notable little book, of interest to the amateur and of value to the expert.

(2) In this book the authors have attempted the somewhat difficult task of acting as a guide to the farmer who proposes to purchase an internal combustion engine for any power purpose. Though the book is entitled "Farm Gas Engines," it is really mainly concerned with engines using liquid fuel, such as gasoline and kerosene. Of necessity but little theory is given, and the main part of the book is wisely devoted to discussions of the essential points in the design of the working parts of these engines. When a non-expert is considering the suitability of any particular type of engine for his purposes, there are certain details of construction to which he should devote especial attention, and on this matter excellent advice is given in this little book. Though practically only American types of farm engines are discussed by the authors, nevertheless the information and advice given in the chapters devoted to details of engine construction will be found useful by any British farmer who has already obtained, or thinks of obtaining, an internal combustion engine of any type.

(3) It is just twenty years since Dr. Rudolph Diesel published a pamphlet in which he dealt fully with the principles which must govern engine design when the object aimed at is to secure the maximum possible thermal efficiency, and now the Diesel engine has become such a serious rival of the steam engine that it has even been utilised for locomotive work; it is only natural, therefore, that special text-books should be devoted to the theory and construction of the

Diesel or slow-combustion oil engine, as the authors term it.

The authors, in addition to much original matter, have brought together into convenient form for reference the results of experimental work and the information in regard to constructive details published in the columns of the technical Press of the past ten years, or embodied in the numerous papers read before the leading engineering societies of the world; for this reason alone the book will prove invaluable both to the many engineering firms which now build these engines, and to the engineers who have installed them in power stations, factories, and ships.

The first four chapters deal with the theory of the laws of perfect gases, the work which can be obtained from a given volume of gas when expanding under given conditions, and the application of the well-known entropy diagrams to the study of the internal combustion engine. The next chapter deals with oil fuels suitable for these engines, their physical properties and methods of transport, and storage; in this connection the authors refer to the vast shale deposits in Australia, and to their utilisation for the production of oils for power purposes in that continent. In connection with the question of the cost of power generated by Diesel engines, it may be mentioned that in a test of a 200 b.h.p. two-cylinder four-stroke cycle engine, Mr. Eberle obtained under full load a thermal efficiency of 34·2 per cent. reckoned on the b.h.p., a wonderfully good result. In connection with the testing of Diesel engines the authors give some useful advice as to the care and attention necessary in order to maintain a high state of efficiency.

In view of the importance to designers of Diesel engines of a thorough knowledge of the theory and practice of air compression, the authors have wisely devoted a whole chapter to this subject, and have done their work admirably. The ninth chapter deals with the data and calculations needed in the design of cylinders, crankshafts, valves, flywheels, and reversing gears, while the concluding chapter is devoted to an account, well illustrated, of a number of recently-constructed Diesel engines for all classes of land and marine work; it is in connection with marine work that the greatest advance has taken place in the last two or three years. In an appendix the authors give a most useful abridgment of the principal patents connected with this remarkable motor and its developments.

(4) In this volume, which forms one of a series of text-books on the chemistry of the national industries, Mr. Searle deals with the three important building materials—cements, concrete, and bricks. The importance of a knowledge of chemistry in the manufacture of cement has been long recognised, and to this fact is due the great advance this industry has made during the past twenty years, but it is only recently that the value of chemical research to the brickmaker has been fully realised. In the first five chapters the author deals with cement, most attention being given naturally to Portland cement; he discusses fully the necessary properties of the raw materials, and the various methods of manufacture; Mr. Searle is of opinion that with equal care and skill both the older wet process and the modern dry process produce good results. The chemical and physical changes which occur both in the manufacture and in the setting of cements are most fully and thoroughly discussed, especially the chemical relations between the lime, alumina, and silica. In chapter v. the question of the testing of cement is taken up, the various methods adopted are fully explained, and the importance of cement-sand tests is clearly brought out, the author expressing his opinion that tensile tests of neat cement are largely futile; in dealing with the tests for soundness it is shown that this is a test which it is difficult to carry out with accuracy, and that, as a matter of fact, the majority of the Portland cements now on the market will pass all the ordinary tests for soundness.

Two chapters are devoted to the components of concrete and its preparation, and much excellent practical advice is given; then follows a chapter on reinforced concrete; the author points out that many of the formulæ now used in calculation work contain constants, which in the hands of the experienced man are safely used, but when used by a beginner may lead to serious blunders. The remainder of the book is devoted to brickmaking; the chemical and physical properties of the raw materials are fully discussed, the various processes of manufacture described, and the properties of finished bricks of various classes explained. Mr. Searle has written a thoroughly sound, valuable text-book, which ought to prove of great service to manufacturers, builders, and architects.

T. H. B.

OUR BOOKSHELF.

Lehrbuch der Paläozoologie. Teil ii., Wirbeltiere. By Dr. E. F. Stromer v. Reichenbach. Pp. ix+32. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 10 marks.

The second part of Dr. Stromer's text-book of palæozoology deals with the fossil vertebrates in the same concise and philosophical manner as his previous account of the invertebrates. The descriptive sections comprise only just such conspicuous families and genera as are needed by a student who seeks a broad view of the subject; and at the end of the chapter on each class there is a brief summary of the leading features in the geological distribution and evolution of the class as a whole, with a table of diagnoses of its larger subdivisions. A useful list of the principal papers and books published during the last few years is also appended. The text throughout is well illustrated with drawings of more than usual artistic merit, and although the majority of them are taken, with acknowledgment, from various original works, Dr. Stromer himself has frequently amended them to bring them up-to-date. Some, indeed, are in advance of their formal publication, such as the drawing of the skeleton of the strange clawed ungulate mammal Moropus, contributed by Dr. W. J. Holland. So many are new to a text-book that their appearance is quite refreshing.

In a work designed for elementary teaching it is generally advisable to incline towards conservatism, and Dr. Stromer evidently holds this opinion. Among fishes, for instance, he still recognises the "orders" Ganoidei and Teleostei, though his so-called diagnoses do not define them; and his treatment of the early palæozoic Arthrodira and Ostracodermi is not altogether satisfactory from the modern point of view. His references to the literature, however, will enable the student to examine other views if he wishes to do so.

The last sixty pages of the book are devoted to the general principles of palæontology, and we can recommend this able summary to any zoologist who desires to understand the present position of those who study fossils. A. S. W.

A Treatise on Wooden Trestle Bridges and their Concrete Substitutes. By Wolcott C. Foster. Fourth revised and enlarged edition. Pp. xix + 440. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 21*s.* net.

IN the present edition of this work, which was first published in 1891, will be found a very full account of the construction, erection, maintenance, and preservation of timber trestle bridges. The book is profusely illustrated, and contains working drawings showing the details of the standard trestles used on the principal American railroads. Wooden trestles may be disappearing gradually from main lines of heavy traffic, but the increased growth of branch lines, or feeders, and of trestles at manufacturing plants and for electric railways, have probably more than kept pace with its abandonment on main lines. There is, on the average, about 100 ft. of bridges and trestles to each mile of railroad in the United States. The wearing out of wooden trestles and the increasing cost and scarcity of timber suitable for their replacement has taxed the ingenuity of railroad officials to find suitable structures to take their place. In some cases iron or steel structures have been employed, but there are numerous districts where local conditions make these methods so expensive as to be prohibitive.

In the past few years a number of roads have used concrete trestles in replacing those constructed of timber, and the author gives full particulars of reinforced concrete trestles and slabs which form a structure closely in line with the main features of the timber trestle. The book provides a great deal of valuable information regarding the strength, durability, and preservation of timber under all kinds of practical conditions, and therefore will be of service to British engineers, despite the fact that timber bridges do not occur often on British railways.

Durch König Tschulalongkorns Reich. Eine deutsche Siam-Expedition. By Dr. Carl C. Hosseus. Pp. xii + 219 + plates. (Stuttgart: Stecker and Schroder, n.d.) Price 15 marks.

DR. C. C. HOSSEUS, who visited Siam in 1904–06, gives us in the present volume an account of his journey and scientific observations. The route lay up the Mäping, and at various halting-places excursions were made to the neighbouring country. Chiengmai appears to have been his chief base, and from there Doi Intanon, Chieng Dao, Pahombuk, and Chiengrai, to mention only a few of the more important, were visited.

Zoologists, geologists, ethnologists, geographers, and other naturalists will all find much to interest them in the book; for quite a casual glance through its pages will suffice to show that the author was ever on the alert to note points of interest in any branch of science. But it is undoubtedly to the botanist that the author has in the first place appealed.

Previous to this work the author had published lists of his botanical collections, so that here we have no complete catalogue, but references are given to the new species found and to many others interesting for some morphological detail or for their associations. Here it may be noted that the index, copious though it may appear, is not a complete index to all the plants mentioned.

A word of praise is due for the numerous excellent illustrations included at the end of the book. All who are interested in Asiatic botany must feel indebted to Dr. Hosseus, to whom must be attributed the credit of being the first scientific traveller and collector on a large scale north of Bangkok, for supplementing his previous lists with such an interesting book.

Biology: General and Medical. By Prof. Joseph McFarland. Pp. 457, with 160 illustrations. Second edition. (Philadelphia and London: W. B. Saunders Co., 1913.) Price 7*s.* 6*d.* net.

THE first edition of Prof. McFarland's book appeared in 1910, and was reviewed at length in the issue of NATURE for March 23, 1911 (vol. lxxxvi., p. 106). In the present edition the author has endeavoured to eliminate defects discovered in the book, and without much increasing its size to introduce the new matter necessary to bring it up to date.

LETTERS TO THE EDITOR.

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

The Constitution of Atoms and Molecules.

Dr. van den Broek's letter (Nature, May 7, p. 241) contains one or two misapprehensions of the views put forward in my paper (*Phil. Mag.*, April, 1914), and I shall accordingly endeavour to make my meaning clearer. The paper does not purport to show that Dr. van den Broek's hypothesis is incorrect—in fact, in my own belief, it is fundamentally correct, though not necessarily in complete detail—but only to show that it is incompatible with the present form of Bohr's theory. Any atomic theory has two main things to explain in connection with optics—the X-ray spectra investigated by Moseley and the ordinary light spectra of atoms. The fact that coplanar rings are mathematically impossible is conclusive against them, whether on Bohr's theory or the present dynamical one. This must be admitted, in the face of any other evidence which appears to support them. There can be rings of electrons in an atom provided that they are not coplanar, but they must be of the same order of radius. There is only one case in which coplanar rings are possible—the case in which bound electrons *do not repel* each other, which is considered in detail in a paper to be published shortly, but such a supposition is in complete contrast to the present form of Bohr's theory.

As my letter to Nature pointed out, we do not require an inner ring in order to explain X-rays having lengths of the order 10^{-8}. They can come from an ordinary ring of atomic size if the nucleus is of strength 10 or more, and the Balmer lines can be considered as an X-ray spectrum of hydrogen. X-rays can even come from the confines of a structural nucleus. Many physicists have not yet realised that the size of the wave-length given by a ring bears no fundamental relation to its radius alone. The *angular velocity* of the ring is the important deciding factor. If we suppose that the frequency of a line is the frequency of the vibration of the ring about its steady rotation, dynamics shows that it is of the same order as the frequency of rotation, w. If C is the velocity of light, the wave-length is of order C/w, and a ring of *any* radius can give any wave-length if it rotates with the proper angular velocity. So also can any portion of a structural nucleus, and, coplanar rings being impossible, the X-rays can come from the nucleus. The wave-lengths on Bohr's theory are also determined by the order C/w, and not in any fundamental way by the radius, as may be seen by an examination of Bohr's mathematics.

Although it is the only published attempt, Bohr's theory does not constitute the only one which can be suggested to deal with Moseley's results. The writer has obtained, for example, a simpler explanation of them by more ordinary dynamics, which will shortly be published, by attaching a definite structure to the nucleus—a structure which can explain a great deal more in connection with such phenomena as the velocity of emitted α particles. In this method, the meaning of N is essentially the same as in Dr. van den Broek's hypothesis. The difference is in detail only. It is not possible to dispute Moseley's contention that there is a fundamental number which changes by steps of 1 in passing from one element to another in the table, nor that it is an "atomic number" related to the charge on the nucleus. But there is an assumption—perhaps correct—made in identifying it with the *exact* place occupied by an element in the table as we now know it, and Bohr's theory is incompatible with this assumption. For the paper showed that if the atomic number of lithium, for example, is 3, it must (1) have no valency on Bohr's theory, and (2) it must have all its electrons in one ring, or moving in a manner prohibiting any two of them from forming a ring. The radii of the orbits of the two inner electrons cannot be more nearly equal than in the ratio 12 to 1.

Again, as in another paper (*Monthly Notices of R.A.S.*, April, 1914), no approach to the ordinary helium spectrum can be obtained from Bohr's theory if the atomic number of helium is 2. These are only illustrations of much more decisive results. They have related, in the work published already, to the supposition that the laws of force between bound electrons are those used by Bohr. But they are equally valid for other laws of force. The one case in which the coplanar rings can exist—when bound electrons experience no force from each other—is the only avenue towards the extension of the theory. But it has difficulties, and, in particular, it gives no place to Moseley's constant b, which is then zero in all atoms. The K radiation then leads to the conclusion that the atomic number usually differs by 1 from the place of the element in the table. Dr. van den Broek lays stress on the fact that $N-b$ changes from one element to another, and not N. But we must repeat, quite definitely, that b is zero in the only modification of Bohr's theory which can have more than one coplanar ring. By this statement, however, we do not imply that b has no existence in fact. Its different values for K and L radiation demonstrate that it is real. The theory would demand an identity of these radiations even if they came from different rings, when such rings can exist. A reconciliation with experiment can only be obtained by putting the electrons as a constituent part of the nucleus itself, or by supposing that X-radiation comes from the confines of the atom—the K type from a neutral atom, and the L type perhaps from an atom which has lost an electron. But this latter alternative is quite at variance with Dr. van den Broek's hypothesis, when calculations are performed, and the first has no relation to Bohr's theory.

The strongest argument in favour of Dr. van den Broek is the recent generalisation of the periodic table put forward by Soddy and Fajans, against which mathematical considerations cannot be raised; in fact, they tend to support it. This generalisation, however, in no case demands a strict identity between the nucleus charge, and the place in the table. The other phenomena depending on the atomic number could depend equally well, within the order of accuracy, on a number which differed from it by 1 or 2. In conclusion, so far as the table is concerned, Dr. van den Broek may be completely correct, but, if so, Bohr's theory cannot be modified to take account of X-ray spectra. The periodic table, however, is not a sufficient test. Astrophysical spectra demand, as proved in many papers in the *Monthly Notices*, the existence of simple "elements" the spectra of which can be calculated, which not only agree with actual spectra, but also have actually led to the discovery of several lines which the formulæ predicted. The atomic weight of one of these, with 6 electrons, is 2·94, as calculated theoretically. By an application of their interference method to a line in nebulæ, MM. Bourget, Buisson, and Fabry (*Comptes rendus*, April 6, 1914) have verified this value for the mass of the atom which emits the line. They have also made preliminary experiments on another element, and found results which support the theoretical value of the atomic weight, 1·31. Very simple elements can exist therefore in which the atomic number differs from the number of electrons, and Dr. van den Broek's hypothesis cannot be a complete principle, although perhaps satisfactory for the stable terrestrial elements. Nevertheless, if it is satisfactory in this range, Bohr's theory is not. J. W. NICHOLSON.

King's College (University of London).

Temperature-Difference between the Up and Down Traces of Sounding-Balloon Diagrams.

IN his paper on the daily temperature change at great heights (January issue of the Quart. Journal of the Roy. Met. Soc.), Mr. Dines deals with the double traces shown by the diagrams of registering-balloons. He ascribes the difference for a great deal to the heating effect of the balloons, as the instruments swim in the wake of dead but heated air that follows the ascending balloon.

He rejects as a possible cause any thermal lagging of the instrument, because the double trace is most apparent in the isothermal layer, and also because it mostly occurs by day and not by night.

Receiving this number of the Quart. Journal, it just happened that I had made a synopsis of this kind of temperature-difference for the Batavian ascents, which throws another light on this question.

At Batavia the balloons are of a larger type than those used in England; also the string between balloon and instrument is much longer, measuring 30 m. and more. Moreover, it has been observed in numerous cases that up to the greatest heights the whole system of balloon-parachute-instrument often swings strongly. Accordingly any heating effect by the air in the wake of the balloon seems most improbable.

The instruments are of the pattern usual on the continent and made by Bosch (Strassburg); they are provided with clockwork. When possible the heights have been calculated separately for the ascent and the descent; thus, when the downward temperatures were found to be lower than the upward, the corresponding heights became lower, and accordingly the difference of temperature for the same calculated height in the ascent and the descent was increased. In half of the thirty ascents which up to the present have been made, the balloon was liberated 1–1½ hours before, and in the other half 1–1½ hours after sunrise. Thus, in the first cases only the latter part of the descent took place at an hour that solar radiation begins to be active.

The mean differences found are:—

Temperature Higher in the Ascent than in the Descent.

Height in km.	Before sunrise °C.	After sunrise °C.	Number of cases Before	After
1	0·0	0·4	16	14
2	0·1	0·4	18	14
3	0·4	0·0	18	16
4	0·2	1·4	18	16
5	0·2	1·5	17	15
6	0·7	2·4	16	15
7	1·0	3·0	17	12
8	1·2	3·3	15	13
9	1·3	3·2	15	12
10	2·2	4·4	15	11
11	2·7	4·6	15	11
12	3·0	4·3	15	11
13	3·4	5·0	15	10
14	3·8	3·6	13	9
15	3·3	2·9	12	9
16	3·5	2·5	6	5

The prominent fact, demonstrated by this table, is that up to 13 km. the differences before sunrise are much smaller than those after sunrise.

The synopsis teaches, that before sunrise negative values occur in all heights, especially below 7 km. In one case up to the stratosphere the difference was negative in all heights.

On the contrary, in another ascent it went up to 9·2°. After sunrise no ascent, with negative values only, occurred, and in one case the differences amounted to 11·2°.

For the stratosphere, only in eight cases a set of these differences was obtained, its height being so great in these low latitudes that only part of the balloons reach its layers. Only in one of these cases (after sunrise) the descent-temperatures in the stratosphere exceeded those of the ascent, and in another case (before sunrise) higher temperatures alternated with lower.

In the five other cases (before sunrise) the sign of the differences in and below the stratosphere were contrary. It must be borne in mind that scarcely any isothermal state prevails in the tropical stratosphere, but that the temperature increases with the height (*cf.* my letter in NATURE of March 5, p. 5).

However, in the above-mentioned case of alternating positive and negative values, isothermal condition was met with up to 23 km.

The reversal in sign of the difference, which accompanies the reversal of the temperature gradient, strongly points to a thermal lagging of the instrument. Its heavy parts, and the basket also, will lag strongly and will influence the thermograph. In the ascent the lesser the ventilation the greater the heating. Thus the influence will increase with the height, as the ventilation decreases. In the descent the ventilation in most cases was greater than in the ascent, and accordingly the negative lagging less. After sunrise the thermal lagging of the basket will be enhanced in the ascent by sun-radiation, which easily explains the fact that the differences are larger after than before sunrise.

Perhaps the English instruments, being smaller than the German, have a smaller thermal lag than the latter. Thus Mr. Dines's explanation may be applicable to the facts observed in England, and mine to those met with in Java. From them I think the following lessons may be learnt, which applies to most Continental ascents made in a similar way and with the same pattern of instruments:—

(1) The temperatures of ascent and descent should be averaged.

(2) When descent or ascent is available only, a mean correction, to be derived from a large number of corresponding cases, should be applied.

(3) The temperatures and heights taken from the publication of the International Committee, in which, in most of the cases, ascents only are given, are affected by a systematic error.

W. VAN BEMMELEN.

Batavia, March, 1914.

Cellular Structure of Emulsions.

THE same arrangement that is shown by Fig. 2, in NATURE of May 7 (p. 240), may be seen in an emulsion of Oriental finely powdered coffee suspended in milk and water. I have supposed that it is connected with a strange phenomenon which I reported in NATURE about forty years ago. Sooty rain-water, after standing for some hours, will develop clear planes of water, as much as 10 cm. long and only 1 or 2 mm. wide. These planes are most readily seen by candle light when vertical, but may develop at any inclination, and change inclination. Such a straight segregation of clean water shows that no self-attraction of the suspended solids can be the cause. In a recent point of view it looks like a liquid crystal arrangement of water expelling the powder as foreign matter, especially when we remember the habit of ice crystals in very thin plates. The question then arises, Are all these emulsion figures due to the clear liquid segregating and expelling the suspended matter?

W. M. Flinders Petrie.

MODERN FORMS OF RÖNTGEN-RAY TUBES.

In spite of many obstacles, medical technique in the application of Röntgen rays has made steady progress during recent years. But there still remain certain primary difficulties which are often a source of hindrance and confusion. The demand for a more trustworthy method of working than exists to-day is the natural outcome of wider radio-therapeutic experience, but what is required above all is an accurate means of measuring the output of the tube.

The solution of this problem clearly requires that we shall have at our disposal an apparatus capable of emitting a specific type of ray in definite quantity; and were it not for some experiments by Dr. Lilienfeld, and more recently by Mr. Coolidge, of New York, there would be little prospect of actually realising this result in practice. I shall refer to their work more in detail later.

Meanwhile, it is worth noticing that the modern X-ray tube, with all its imperfections, is a triumph of craftsmanship. It is the result of numberless costly and difficult experiments carried out by manufacturers and others to meet a demand which grows more exacting every year. The collection of historical X-ray tubes brought together some time ago by the Röntgen Society, and now on view in the Science Museum at South Kensington, contains the first bulb which embodied the chief features adopted universally up to the present time in the construction of X-ray tubes. That bulb was made by Prof. Herbert Jackson in 1896, and measures only 3 in. across. The diameter of those in use to-day is, however, usually twice or three times as great, the electrodes being heavy and the vacuum carefully adjusted.

The successful working of the apparatus depends so largely upon this last factor that decrease in pressure of the residual gas, invariably accompanying prolonged use, has to be compensated for. The devices employed for regulating the vacuum may be divided into three main classes, viz., those :—

(1) In which a few discs of mica, a piece of carbon or asbestos, etc., fixed within the bulb, offer an alternative path for the discharge, so that gas is, when necessary, liberated by the heat generated, as the electric current follows the line of least resistance.

(2) In which a fine palladium tube stopped up at one end has a small tubular extension of platinum soldered to it for sealing into the X-ray bulb. A gas flame brought near so as to heat the palladium enables hydrogen to enter by osmosis, and so lower the vacuum. All the tubes used in the X-ray treatment cubicles at the London Hospital, for instance, have these "Osmo" regulators.

(3) In which air is allowed to enter through the pores of a piece of unglazed porcelain, which is usually sealed with mercury until by a pneumatic contrivance it is momentarily uncovered.

But none of these methods is free from objections. The regulation is generally too insensitive. The tube often outlives the supply of gas from the first sort, and the others are only trustworthy in skilled hands. The mica disc regulator is shown in the diagram (Fig. 1), which otherwise is self-explanatory.

Messrs. C. H. F. Muller describe some eighteen types of tubes of this character in their recently

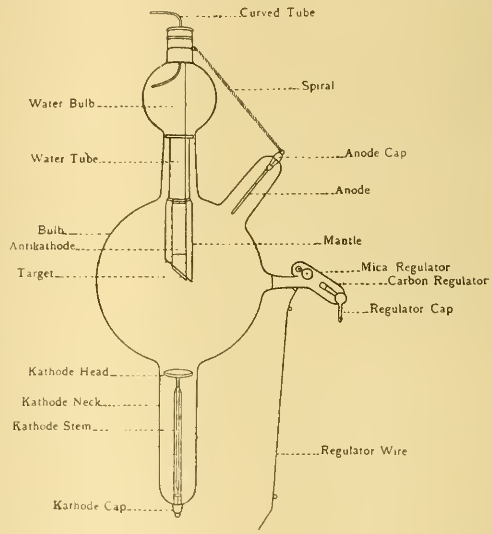

Fig. 1.—Showing the terms in common use to denote the different parts of the instrument.

published catalogue, and give precise instructions for the adjustment and use of each kind. There are in addition five coloured plates showing the appearance of X-ray bulbs in action, and a great amount of useful information besides. Fig. 2 (Muller) may be taken as representing a typical example of modern heavy discharge X-ray tube.

The cause of the disappearance of gas with prolonged use has given rise to much speculation. It has been suggested that the ions produced by the discharge are driven actually through the walls, and so escape; there is proof at least that the glass takes up a large part of the residual gas under these conditions, and that lead glass absorbs more than Jena.

Since the degree of vacuum controls the resistance of the tube, and this in turn determines the current that passes with a given potential difference between the electrodes, it is evident that the pressure of the residual gas is the chief factor which defines the type and quantity of rays to be obtained. Moreover, the kathode itself must carry a minute trace of gas to facilitate the transfer of electricity from the metal to the surrounding space. Further, the great heat often generated at the antikathode raises the temperature of the walls to such an extent that gas is set free there, and the balance of working conditions upset. A new tube, in fact, generally requires "maturing" until its vacuum when at work will keep practically constant, and yet be neither too high nor too low. This calls for much care and patience on the part of the operator. A bulb may in this way be coaxed to carry 5 milliamperes for hours at a stretch, and be of great service in "treatment." In most cases, however, the current does not exceed 2 milliamperes for that purpose. But in radiographic work the usual practice is to employ a heavy current—20 milliamperes—for a few seconds or even a fraction of a second. The length of exposure is, of course, determined by a number of considerations, but with such a large current it cannot exceed a few seconds on account of the enormous heat generated at the antikathode by the impact of electrons.

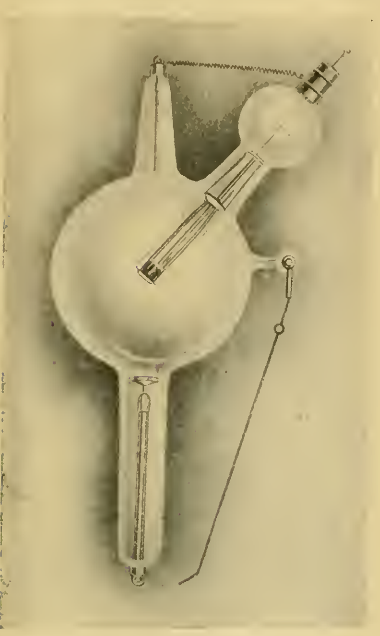

FIG. 2.—Heavy-discharge X-ray tube.

The same difficulty is met with in the treatment tubes, quite apart from the disengagement of gas, for a longer exposure has to be given now than would be necessary if more current could be carried with regularity and safety.

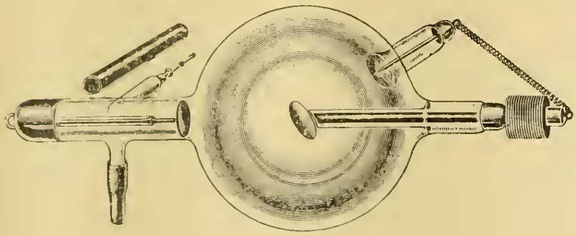

FIG. 3.—Heavy discharge radiator tube.

Under existing conditions the antikathode stem is usually made hollow, so as to enable water or air to flow in and carry off the heat, or an actual radiator may be fitted, as shown in Fig. 3 (Cossor). The osmosis regulator is also represented in the same illustration. Otherwise, even the hardest substance used as target would melt or become pitted by the impinging electrons. As an example of what occurs, the photomicrograph (Fig. 4; for which I am indebted to Dr. Rodman) of a plate of platinoid-nickel which has served as target may be of interest. In all cases except for very light work, the antikathode is made of stout copper faced with platinum-iridium or pure iridium, tantalum, etc., at the place where the kathode rays impinge upon it. The uncertain variation of vacuum, together with the development of excessive heat at the antikathode, constitute the most serious objections to the present system of working. The first difficulty especially hinders progress towards the attainment of an accurate method of measuring or describing the radiation dealt with, for it may change from day to day, or even during an exposure. But there are, in addition, many minor ailments which develop with the age of the tube. Thus a deposit comes gradually upon the inner surface of the walls. It is mainly metallic, and occludes gas; but it also provides electrified areas which disturb the normal streams of electrons. Occasionally, too, patches of bright fluorescence appear on the glass, due to specks of foreign matter sticking to the kathode. The direction of the discharge will sometimes reverse in the tube from no apparent cause. Indeed, the behaviour of a bulb is so erratic at times that a superstitious person might be excused for regarding it with distrust.

FIG. 4.—Photomicrograph of eroded target.

However, with care and experience, and in spite of many disadvantages, splendid work is being done with this super-sensitive apparatus. But it is none the less necessary to make every effort towards placing X-ray therapeutics upon an accurate quantitative basis, and to simplify the technique. With existing appliances the prospect of so doing is remote indeed.

But we are on the eve of great improvements! Dr. Lilienfeld, of Leipzig, has already constructed a Röntgen tube which is so highly exhausted that the residual gas plays no part in the working of the apparatus. The first description of this new departure was given in the *Fortschritte auf dem Gebiete der Röntgenstrahlen* for June, 1913, and more recently a further account has appeared in a later issue (Band xviii., p. 256).[1]

Dr. Lilienfeld creates an electric field in the neighbourhood of the antikathode between an aluminium tube and a white-hot wire. The working potential difference is then applied to the main electrodes and a discharge immediately passes. Since the current taken by the tube depends upon the temperature of the so-called priming device, the operation is under control.

But Mr. Coolidge[2] has simplified this design still further by placing a small spiral of tungsten at the centre of the kathode; heating this by an independent current he obtains a supply of electrons which are repelled and driven against the target with such speed as to produce copious X-rays where they strike. Thus, given a powerful induction coil and noting that the bulb is so well exhausted that 100,000 volts at its electrodes produce no discharge, the spiral is heated and the current that then passes is simply a function of the temperature. Variation of the potential difference would mean an alteration of the speed at which the electrons are driven against the target. The *quality* of the X-rays produced can therefore be varied, irrespective of their quantity. This is not possible with any other type of X-ray tube. Its importance cannot be over-rated. It places in the hands of X-ray operators an instrument of precision. Many questions are still outstanding; it is not even claimed yet that this apparatus is beyond the experimental stage. Meanwhile, however, it may be of interest to point out that the Coolidge tube has already given some remarkable results. The most successful bulb so far made measured 18 cm. in diameter, and was blown from German glass; it carried a current of from 1·7 to 36 milliamperes with the spiral heated to a temperature varying between 2010° and 2240° absolute. It was run for fifty minutes continuously on one occasion with 25 milliamperes passing. There was, of course, great heat developed in the antikathode, but the regularity of the action seems to have been unaffected. No fluorescence appeared upon the glass of this bulb, and the starting and running voltages were identical. The tube is also its own "rectifier," and may be run off an alternating circuit without any additional device to suppress one phase.

The prospect of being able to speed up the electron so much that it may give rise to a radiation with a wave-length equal to, or even shorter than, that of the Gamma ray from radium, offers great therapeutic possibilities.

It remains so far to improve the means of supplying electricity to the tube that a steady potential difference may be maintained at its electrodes. Then, since reversal seems impossible with the Coolidge system, it should be feasible to produce pencils of approximately *homogeneous* X-rays in definitely measurable *quantity* and of a *quality* expressed in terms of the coefficient of absorption in some agreed substance.

An attempt to construct a tube upon the new principle is at present being made in the physics laboratory of the Cancer Hospital, and experiments will be taken in hand there as soon as possible to test the types of ray obtainable by this means.

CHARLES E. S. PHILLIPS.

[1] A good summary is published in the *Archives of the Röntgen Ray*, for February, p. 340

[2] *Physical Review*, December, 1913.

THE SICILIAN EARTHQUAKE OF MAY 8.

THE earthquake which visited the south-east flank of Etna on May 8 is evidently one of the strongest of the local shocks which occur so frequently within the bounds of the volcano. Unlike the Messina earthquake of 1908, the shock was heralded by many slight tremors in the surrounding district, several having been felt every day since April 25. But for these warnings, the loss of life might have been far greater than it was, though more than 150 persons are reported to have been killed and about 500 injured. The villages of Linera, Passapomo, Pennisi, and Zerbati are completely ruined; Cosentini, S. Caterina, and S. Maria Vergina are half-destroyed; while about a dozen other villages from Zafferana and S. Venerina on the north to Trecastagni on the south are seriously damaged.

The epicentre of the earthquake is clearly at and near Linera. The details at present known are insufficient to determine the boundary of the meizoseismal area, but its greatest dimension can scarcely exceed two or three miles. For the same reason, nothing more is known as to the extent of the disturbed area beyond the fact that it was small considering the violence of the shock near the epicentre. Probably the disturbed area is far less than that of some of the weakest of British shocks. This alone proves how rapid was the decline in intensity from the central region. At Acireale, only four miles south of Linera, the damage to property was slight. At Catania, seventeen miles to the south, the shock was felt, and excited some alarm. These two facts—the great intensity near the epicentre and the rapid decline in strength outwards—show that the focus must have been quite close to the surface.

It is, however, in its relations with previous earthquakes in the same region and with the eruptions of the neighbouring volcano, that the interest of the earthquake chiefly lies. Two and a-half years before, on October 15, 1911, a similar, though less destructive, earthquake occurred in the immediate vicinity. The meizoseismal area in this case was a narrow band, four miles long and about a-third of a mile wide, extending from Fondo Macchia to Guardia, and passing about a mile and a-half to the north-east of Linera. On this occasion twelve persons were killed and forty-eight injured. On July 19, 1865, the same district was ruined by an earthquake, by which seventy-four persons were killed and fifty-six injured. Other shocks visited the same or neighbouring villages on July 11, 1805, and January 26, 1859; while, from 1893 to 1900, twenty-seven strong shocks were felt, six of them being of ruinous strength.

Many of these earthquakes were closely connected as regards time with Etnean eruptions. The earthquake of 1805 occurred after, and that of 1859 during, a period of activity. The earthquake of 1865 took place eighty-eight days after the conclusion of a violent eruption; and that of 1911 twenty-two days after the close of the last eruption, which began on September 10 of that year and lasted for twenty-three days. The recent shock occurred about two years and eight months after the end of the same eruption.

The same phenomena seem to characterise all the earthquakes of this district. The disturbed area is small, the intensity of the shock great in its central portion, and the isoseismal lines extremely elongated in form. In some cases the axes of the isoseismal lines are directed towards the central crater; in others (as in the earthquake of 1911) in a perpendicular direction. The small depths of the foci, their situation within the Etnean boundary, the direction of the meizoseismal bands, and the close connection of many of the earthquakes with eruptions of Etna—all these phenomena point clearly to the volcanic origin of the earthquakes, their immediate cause being probably local slips along radial and peripheral fissures.[1] C. Davison.

[1] M. Baratta, I terremoti d'Italia, 1901, pp. 829–33; A. Riccò, Boll. Soc. Sis. Ital., vol. xvi., 1912, pp. 9–38.

THE BACHELET LEVITATED RAILWAY.

THE daily Press, or rather a section of it, has been greatly excited during the past week by the exhibition of a model railway, the invention of M. Emile Bachelet, in which a metal carriage is levitated in the air above the rails in a model railway, and then flung forward with very great speed through a series of solenoids. The reporters for the daily Press have discovered new and tremendous possibilities in a scientific principle entirely new to them, but which has been perfectly well known to every electrician and physicist for the last twenty-five years.

The repulsion of a metal plate or ring by an electromagnet or coil carrying an alternating current was discovered independently by Dr. J. A. Fleming and by Prof. Elihu Thomson. In 1887 Dr. Fleming invented and described in the *Electrician* of March 25, 1887, an alternating current galvanometer, in which a copper disk suspended in the interior of a coil carrying an alternating current was repelled and deflected. On June 10, 1887, Prof. Elihu Thomson published in the *Electrician* a lecture on novel phenomena of alternating currents, in which he described the repulsion of copper disks and rings by an alternating electromagnet. Prof. Thomson's apparatus was exhibited at the Paris Exhibition in 1889, and the experiments shown by Prof. Fleming to the Royal Society of Arts in a lecture in May, 1890, and also at a Royal Society *soirée* in the same year, as well as at a Friday evening discourse at the Royal Institution in March, 1891.

Dr. Fleming expounded the whole matter with numerous striking illustrations. Heavy copper rings were made to float in the air, or were shot up into the air with great velocity. This repulsion is due to the repulsion between the currents in the magnet coil and the eddy curents set up by the alternating field in the plate or ring.

The principle was applied by Prof. Elihu Thomson in the invention of an alternating current electric motor, and it has been developed in the well-known compensated repulsion motor of Winter and Eichberg. It is also applied in several forms of rotating and recording electric meter. The phenomena known as "electromagnetic repulsion" are therefore perfectly familiar to electrical engineers, and except in the ingenious application to the support of a model railway carriage there is nothing new. Press reporters and others who have been astonished by the exhibition of this force are merely learning afresh facts which were publicly exhibited and described by Profs. Fleming and Elihu Thomson nearly a quarter of a century ago. Careful experiments and quantitative measurements will, however, be necessary before any valid opinion can be formed whether the principle admits of economical application in the propulsion of real railway trains. Nevertheless M. Bachelet deserves credit for his highly ingenious application of this well-known principle of electromagnetic repulsion.

NOTES.

Lord Lamington, G.C.M.G., G.C.I.E., has consented to be president of the Research Defence Society, in succession to the late Sir David Gill, K.C.B., F.R.S.

On the recommendation of the council and of the special committee on the Hayden award, the Academy of Natural Sciences of Philadelphia has this year conferred the memorial gold medal on Dr. Henry Fairfield Osborn, in recognition of his distinguished work in vertebrate palæontology.

At the annual meeting of the Irish Forestry Society on April 23, it was stated by Prof. Campbell that the department hoped to secure 15,000 acres for State forestry in Ireland. A grant had been obtained from the Development Commissioners of 31,430*l.*, spread over fifty-two years, for a scheme of forestry in Cork, and the department is applying for a further grant of 45,000*l.* It is thus evident that State forestry in Ireland has broken ground in earnest, and this makes it all the more remarkable that State forestry in England and Scotland should still be waiting to start.

The sixtieth general meeting of the Institution of Mining Engineers will be held in London, on Thursday, June 4, in the rooms of the Geological Society, under the presidency of Sir William E. Garforth. The following papers will be read, or taken as read:—Sinking and equipment of Blackhall Colliery for the Horden Collieries, Ltd., J. J. Prest and J. Leggat; development of the internal-combustion engine for power generation at collieries, J. Davidson; the geology of the Kent coalfield, Dr. E. A. Newell Arber. In addition, certain papers which have already appeared in the Transactions of the society will be open for discussion.

The death is reported, in his seventy-fifth year, of Mr. Newton H. Winchell, State Geologist of Minnesota from 1872 to 1900, and professor of mineralogy at the University of Minnesota from 1873 to 1900. In 1888 he founded the *American Geologist*, which he continued to edit until 1905. He was the author of "Geology of Ohio and Minnesota," "The Iron Ores of Minnesota" (in collaboration with his son, Mr. Horace V. Winchell), "Elements of Optical Mineralogy," and "The Aborigines of Minnesota." Mr. Winchell was three times elected to the presidency of the Minnesota Academy of Sciences, of which he was the founder. Since 1906 he had been archæologist to the Minnesota Historical Society.

The President of the Local Government Board has appointed a Departmental Committee "to consider the present state of the law with regard to the pollution of the air by smoke and other noxious vapours, and its administration, and to advise what steps are desirable and practicable with the view of diminishing the evils still arising from such pollution." The Committee will consist of :—The Right Hon. Russell Rea, M.P., Mr. H. Brevitt, Prof. J. B. Cohen, F.R.S., Colonel H. Hughes, C.B., Mr. J. F. MacCabe, the Right Hon. Lord Newton, Captain H. R. Sankey, Mr. B. Duncomb Sells, Mr. P. C. Simmons, Mr. E. D. Simon, Mr. W. B. Smith, Mr. H. O. Stutchbury, Mr. Christopher Turner, and Sir Aston Webb, C.B. Mr. E. A. Faunch, of the Local Government Board, will act as secretary of the Committee.

In an article published in the *Times* of May 8 attention is directed to the great practical difficulties presented by the problem of the prevention of the spread of sleeping sickness in Uganda, and especially to that of obtaining the cooperation of the natives in carrying out preventive measures. Whatever the chiefs, wishing to stand well with the administration, may profess to believe, there can be no doubt that the native equivalent of "the man in the street" has no faith at all in the assertion of European science that the tsetse-fly is responsible for the spread of the disease; he points to the indisputable fact that the fly was there long before the disease, and he asks why, amongst the many hordes of biting flies, mosquitoes and other insects, should the tsetse alone be blamed? The further fact that the disease did not appear in the country until the Pax Britannica permitted natives to make long journeys in safety, and thus enabled persons infected elsewhere to enter the country, infect the fly, and so start the deadly epidemic, lends colour to the sinister suspicion that the Europeans introduced the disease into the country in order to establish effectually their dominion over its inhabitants. The writer in the *Times* refers to the comparative freedom from natural enemies enjoyed by the adult tsetse-fly, by reason of its alertness and swiftness of flight, but he seems to have forgotten that the insect passes a not inconsiderable period of its existence as a helpless pupa, buried close to the surface of the soil, and therefore much more easily destroyed.

An account of some of the discoveries of expeditions to Peru in 1911–1912 was given by Prof. H. Bingham in Nature of March 26. A new expedition has just started for the same region. As in 1912, the expedition is under the joint auspices of Yale University and the National Geographic Society. Unlike former expeditions, it will cover a period of two years, instead of being confined to one field season. The plan of work will include the making of a topographical map of the region north-west of Cuzco, between the Apurimac and Urubamba rivers; a detailed geographical reconnaissance of the more lofty portions of the mountains, including a study of the large undescribed glaciated region; the establishment of two meteorological stations at different elevations for the taking of systematic records for two years; a study of the distribution and history of food plants of this region; the collection of data respecting the forms and distribution of vertebrates, particularly mammals and reptiles; a survey of the present Indians inhabiting this region, including a study of their dialects, the collection of anthropometric data, and the collection and study of the skeletal remains; an archæological reconnaissance of the entire area, and a continuation of the studies begun by the first expedition, looking toward a geographical interpretation of the Spanish chronicles of the era of discovery and exploration, with particular reference to the identification of ancient place names, the story of Macchu Pichu, and its connection with the history of the Incas.

The issue of the Journal of the Royal Anthropological Institute, July–December, 1913, is largely devoted to the ethnology of Africa. Sir H. H. Johnston contributes a masterly survey of the general question. One of his most important suggestions is that the cattle-keeping communities of the Central Sudan and of Bantu Africa owe much of the slight Caucasian element in their blood and almost all their culture to infiltration from ancient Egypt, rather than to influences from Galaland and Somaliland. In the same connection Prof. Seligmann's elaborate article on some aspects of the Hamitic problem in the Anglo-Egyptian Sudan deserves attention. He supports the suggestion made by Dr. J. G. Frazer in the recent edition of his "Attis, Adonis, Osiris," that the killing of the Shilluk rain-maker or divine king can best be understood in connection with the yearly renascence of vegetation.

The Huxley Memorial Lecture, by Prof. W. J. Sollas, published in the July–December, 1913, issue of the Journal of the Royal Anthropological Institute, is devoted to an account of the exploration of the Paviland Cave at the base of the limestone cliffs of Gower, looking over the waters of the Bristol Channel. It belongs to the Aurignacian period, and the hunters who found shelter there were men of large stature, members of that Crô-Magnon race which occupied during that period the greater part of habitable Europe. They possessed highly developed brains, and had acquired such simple mechanical arts as are essential to primitive man. They had little artistic ability, and have left no recognisable drawings on ivory or bone, the red stripes discovered by Abbé Breuil and Prof. Sollas in the neighbouring cave of Bacon Hole being the only attempts at mural decoration which this race is known to have left behind in Wales. They wore rude ornaments, doubtless exercised some magical arts, and they respected their dead sufficiently to provide for them a ceremonial burial. Whether the Mousterians, their predecessors, occupied this cave is doubtful, nor is it certain that they were followed here by the Solutrians or Magdalenians. Prof. Sollas has thus opened up a new and interesting chapter in the prehistoric archæology of Great Britain.

During the last two months excavations have been carried on in a brickfield to the north of Ipswich with the object of discovering and collecting flint implements of probable Lower-Middle Aurignac-Palæolithic age, which are known to occur at a well-marked "occupation level" at varying depths round the sides of the small valley in which the brickfield is situated. Mr. J. Reid Moir informs us that on April 30 digging was commenced at a spot on the south side of this valley, and a section was exposed consisting of 2 ft. of sandy surface material with 2 ft. 3 in. of undisturbed sand below it. At the base of the section the solid London Clay was met with, and on the surface of this clay, under the compact, undisturbed sand many fragments of pottery, calcined flints, and the remains of a hearth were found. A large piece of pottery was found and photographed *in situ*. The pottery was carefully removed, and has been forwarded to the British Museum, Bloomsbury, where it is being examined. It was in an extremely soft and friable condition, contains many fragments of white quartz, and is of a primitive and rudimentary kind.

The first memoir issued by the South African Institute for Medical Research is an inquiry, by Mr. G. D. Maynard, into the etiology, manifestations and prevention of pneumonia amongst natives on the Rand recruited from tropical areas (published by the institute, Johannesburg, price 5*s*.). Mr. Maynard has availed himself of modern statistical methods and finds, among other interesting results, that the attack and death-rates from pneumonia are influenced by the country of origin of the natives, that the highest attack-rates are found among the gangs which have the lowest physique, and that the prophylactic inoculations with a pneumococcus vaccine appear to reduce the incidence of pneumonia during a limited period. Mr. Maynard's results appear to show that the effect of such immunisation is transitory, the period during which some protection is afforded not exceeding four months, and that little reduction of the case mortality is attained. The paper should be read in conjunction with those of Sir Almroth Wright and his colleagues, who approach the subject from a somewhat different point of view.

We have been favoured with a separate copy of an illustrated article, by Mr. A. Gallardo, from vol. xxvi. of the *An. Mus. Nac. Hist. Nat. Buenos Aires*, on the new museum of natural history it is proposed to erect in Buenos Aires, for which a considerable amount of money has been voted already. The building, which is to comprise all the essential features of an up-to-date museum, is to be in a modification of the Louis XVI. style, and will comprise a basement, a ground-floor, and a first-floor.

Although isolated mammalian remains of Sarmatian age have been known for some time from the Crimea, it was not till 1908 that a regular deposit of these was discovered, and this, too, in the very heart of Sebastopol itself during certain municipal works. The fauna, a part of which is described by Mr. A. Borissiak, with great wealth of illustration, in the *Mém. Com. Géol. St. Pétersbourg*, ser. 2, livr. lxxxvii., 1914, appears to show indications of affinity with the Pikermi fauna on one hand, and that of the Bugti Hill and Siwaliks on the other. An interesting item is a giraffe-like ruminant, regarded as representing a new genus and species, under the name of *Achtiaria expectans*.

The fourth part of vol. viii. of Records of the Indian Museum contains seven articles, by as many writers, on the specimens of various groups of, for the most part invertebrate, animals collected during the Abor Expedition of 1911–12. Among these, it must suffice to refer to a preliminary note on certain groups of the Mollusca by Col. Godwin-Austen, who states that the collection as a whole "is one of the finest and most interesting from the eastern frontier I have ever looked over, containing as it does so many genera and new species, and so many that are quite distinct from land Mollusca at present known from the most western part of Assam." Descriptions of two new species appear in this part, and those of others are to follow.

Missionaries and pioneer explorers of equatorial Africa long ago reported the finding of wild oranges and wild lemons; if the fruits were green, they resembled small limes and lemons, but if ripe their sweet flavour caused them to be classed as oranges. The plants yielding this fruit form the subject of an investigation by Mr. W. T. Swingle and Miss Maud Kellerman, of the United States Bureau of Plant Industry, which is published in No. 5 of vol. i. of the *Journal of Agricultural Research*. It is now clear that these plants have been wrongly classed in the Asiatic genus Limonia, and are more closely related to the Citrus; it is proposed to establish a new genus for these African oranges by raising to generic rank the section Citropsis of Engler. A detailed study is given of the different species of this genus. Interesting results have been obtained as regards the grafting and hybridisation of these plants, and an investigation is being made of their possible uses as a fruit. It is probable that Citropsis will show immunity to diseases and adaptations to soil and climate not possessed by the stocks upon which citrous fruits are usually grafted.

The growing importance of the prickly pear pest in South Africa and Australia has given rise to a search for remedial measures, two of which, the one biological and the other chemical, are described in the March number of the Agricultural Journal of the

Union of South Africa. The first paper, by Dr. Ernest Warren, describes infection experiments with a species of cochineal insect (Green's *Coccus cacti*, var. *ceylonicus*) which showed that, of the two species of prickly pear common in South Africa, the long-spined *Opuntia monocantha* and the small-spined *O. tuna*, only the former succumbed to the attack of the insect, some substance probably being present in the sap of the latter which is injurious to the cochineal insect, since even a wounded surface is not attacked. The second paper, derived from the *Queenslander*, describes a method introduced by Mr. O. C. Roberts, in which treatment consists in the action of arsenious trichloride vapour, at the rate of three quarts of the compound per acre of bush. Up to the present this has only been tested on several hundred acres of land, but the results are said to be sufficiently promising to warrant much more extensive operations in the near future.

STUDENTS of palæobotany will note with pleasure a folio memoir in German on certain fossil calcareous algæ from Japan and China, by Dr. H. Yabe (Sci. Rep. Tôhoku Imp. University, Sendai, Japan, vol. i., No. 1). Only three species are described, but two represent new genera, Metasolenopora and Petrophyton, and the author's well-known care in microscopic details leads to their adequate illustration.

UNDER the title of "Les plus jeunes volcans de la France," Prof. Glangeaud, of Clermont-Ferrand, contributes a well-illustrated account of the chain of the Puys to the *Revue générale des Sciences*, 25e Année (1914), p. 50. The trachytic domes, which are more common in the Mont-d'Or region, are compared with those of the Montagne Pelée and Guadeloupe. Reyer's descriptions of those in Bohemia may provide, however, examples nearer home. A remarkable amount of modern information, including an explanation of the puzzling Puy Chopine, is compressed into this single article.

IN vol. xx. of the *Berichte der naturforschenden Gesellschaft zu Freiburg-im-Breisgau* (1913), W. Deecke discusses the frequent variation in type to be found in European sedimentary rocks of all ages, and concludes that deep marine basins and shallow waters lay side by side, and that the European area always showed, as now, an interlocking of sea and land. Continuous oceanic deposits seem wanting, and the acceptance of this view helps to account for the near association of different sedimentary facies, which other writers have ascribed to the importation of one type over another during lateral thrusting. It may be noted that the author regards the fucoids of the Alpine Flysch, not as algæ or worm-tubes (see NATURE, vol. lxxxv., p. 284), but as sponge-bodies indicative of deep water. In a later paper on "Die Bedeutung salzführender Schichten für tektonische Vorgänge," Deecke ascribes the anomalous position of some of the Alpine masses to gravitational slipping over Triassic strata, from which solution has removed sulphates and chlorides. Such solution takes place easily when the beds are lifted above the usual water-table and are exposed to free percolation, and the author asks for caution before the faulted relation of any overlying mass to its support is ascribed to overthrusting from a distant source. It will be seen that these two papers have a common philosophic aim.

THE Rev. H. V. Gill has sent us a reprint of his paper read at the last meeting of the British Association on the distribution of large earthquakes in time and space. Mr. Gill's theory is that a great mass-displacement of the crust, such as occurs during a violent earthquake, gives rise to a "wobble" or unevenness in the rotation of the earth, which is neutralised by other mass-displacements occurring either in a distant region or regions symmetrically placed along the great circle through the origin, or of displacements in the opposite direction in the neighbourhood of the origin. To test this view, he has examined the distribution of the 889 world-shaking earthquakes recorded by the seismological committee of the British Association. He finds that 674 (or three out of every four) great earthquakes occurred in groups, successive members of which were separated by a week or less, while the remaining 215 were isolated disturbances. Of the former, 163 (or 18·6 per cent. of the whole) belonged to groups of two or more earthquakes occurring at different places symmetrically situated with reference to the origin of the first earthquake of a group; 511 (or 57·1 per cent.) were members of groups occurring at or near the same place. No attempt, however, is made to show that the displacements of individual groups of the latter class occurred in opposite directions.

THE annual report of the Hampstead Scientific Society for 1913 naturally refers with gratification to the favourable reception which was accorded to the publication, "Hampstead Heath: its Geology and Natural History." The membership of the society has attained a "record figure" of 374, with a net increase of thirty for the year. The report contains brief notices of the many valuable papers which have been read to the society, and a summary of the meteorological statistics for the Hampstead Observatory for 1913. "The combination of meteorological circumstances in July was most unusual; coupled with a remarkable cloudiness of eighty-two and an extremely deficient sunshine of only 109 hours were a mean pressure of 30·087 in.—a figure some way in excess of the average—and a rainfall an eighth of an inch below the normal, falling on only eleven days." For the first time, average meteorological data are included in the report; this action marks the fact that the station has been at work for five years. From these preliminary averages it would appear that Hampstead is the coldest, rainiest, snowiest, and frostiest, as well as almost the sunniest and foggiest of the stations in the neighbourhood of London.

THE report of the Royal Prussian Meteorological Institute for the year 1913 (director, Prof. G. Hellmann) exhibits great activity in useful work, relating chiefly to land meteorology and special researches. Arrangements have been made for the preparation of an important work on the climate of Germany, and a special department has been created for the purpose. Among the researches made at the Potsdam Observatory may be mentioned the comparison of different sunshine recorders, and the investigation of unexplained differences which occasionally exist in the indications of ordinary and self-registering rain gauges. The report is accompanied, as in previous years, by several interesting scientific papers. One of these, by Dr. Hellmann, "On the determination of air temperature," bears particularly on the recent discussion on that subject in this country (Nature, April 9, p. 143). Comparisons of readings in a "Stevenson" screen with those of an aspiration thermometer showed that on a sunny day the temperature by the latter might change more than 1° C. within a minute, while the readings in the screen are not so quickly affected by sudden changes. The results seem to indicate, as was also inferred by Dr. J. Aitken, that the screen readings give trustworthy mean values for short intervals (say two to three minutes); a closer agreement than this in the *time* of observing, as Dr. Hellmann remarks, can scarcely be expected.

A new form of Gauss's principle of least constraint forms the subject of a short note by Dr. H. Brell, of Graz, in the Vienna *Sitzungsberichte*, vol. cxxii., p. 7, in which the author obtains a single formula for Appell's equations.

An addition to the numerous tables of logarithms and anti-logarithms that have been published by various writers for special purposes is the "Table auxiliaire d'Intérêts composés" of M. A. Trignart (Paris: Gauthier-Villars, 1914, price 2 francs). This table gives the various powers of the base, 1·0001, for all integral indices from 1 to 1000, for indices in "thousands" from 1000 to 100,000, and for the ten indices completing the range from 100,000 to 1,000,000. In the first two tables the anti-logarithms to this base are calculated to fifteen decimal places. Those in the third table are given to twenty significant figures. It will be observed that to all intents and purposes these anti-logarithms differ from those of the natural system of logarithms in that the fundamental base differs from unity by 1 in 10,000 instead of by an infinitesimal quantity; at the same time it would appear that a similar difference existed in the case of the original logarithms of Napier. The present table is obviously adapted to meet requirements of a special character, such as might perhaps occur in actuarial computations.

Among the reports of recent investigations at the Imperial Institute the first quarterly issue of vol. xii. (1914) of the Bulletin includes papers on the little-known economic products of Somaliland, and on the composition of monazite, which is used extensively in the manufacture of incandescent gas mantles. An illustrated article describes an important plant of rubber-testing machinery set up at the Institute for the purpose of carrying out a systematic investigation of samples of plantation Para rubber specially prepared in Ceylon in different ways, in order to secure accurate data for comparison. A note of agriculture in the Gold Coast states that the cultivation of cocoa is still being extended, and that the crop in 1913 was valued at nearly two and a half millions sterling. The interesting fact, probably not commonly known, is stated that more than one-third of the world's production of cocoa is produced under the British flag.

In part vi. of the *Verhandlungen* of the German Physical Society Dr. F. A. Lindemann shows how the simple method of dimensions may be applied to the construction of atomic models which shall have many of the properties of the actual atoms. Taking the frequency of the electronic oscillations in such an atom to depend only on the distances between the negative and positive charges, the mass of the carriers of the charges, the force between the charges at unit distance apart, and on Planck's constant h, he shows that if the frequency is proportional to the nth power of the force, it must also be proportional to the $(n-1)$th power of the mass, the $(n-2)$th power of the distance and to the $(1-2n)$th power of h. Taking n in succession equal to 0, 1, and 2, he shows how far the model will represent the behaviour of an actual atom without further hypothesis, and what additional hypotheses must be brought in to reproduce given atomic properties. In this way he arrives at the relations previously given by Balmer, Moseley, Bohr, Gehrcke, and others, as holding for the actual atoms.

The flow of sand and other fine materials through openings of various shapes and in different circumstances is not a subject which has received much attention from experimentalists, although it is of considerable practical importance. We welcome therefore the recent work of Prof. E. A. Hersam, of the University of California, on sands of various degrees of coarseness, on crushed slate, crushed shale, mustard seed, and lead shot. From Prof. Hersam's paper in the April number of the Journal of the Franklin Institute we gather that the following are his principal results. The velocity of flow is determined mainly by the size of the particles and of the opening, but is slightly diminished by angularity of the particles or by moisture on them. The specific gravity of the particles, the height of the material above the opening, and the shape of the upper contour of the material have little effect. If D is the diameter of the opening, d that of the particles, both in inches, the mean velocity of flow V in feet per second is given with sufficient accuracy for most practical purposes by the equation, $V=(D-2d)/\sqrt{D}$.

We have received a report by Prof. Ph. A. Guye on the unification of the bibliographic abbreviations in chemical memoirs which was presented at the third session of the council of the "Association internationale des Sociétés chimiques," held at the Institut Solvay at Brussels in September, 1913. The author points out the inconvenience which arises from the same periodical being represented by several different abbreviations, and suggests that a uniform system should be adopted by scientific societies and by authors of chemical works. It appears there are only two systematic methods at present in use, namely, those of the International Catalogue of Scientific Literature and of the Concilium Bibliographicum de Zürich. Neither of these lists is complete, but the author is in favour of adopting the system of the International Catalogue, which is under the control of the Regional

Bureaus of twenty-six States and of five societies, and is therefore truly international. The International Catalogue has four regulations for the abbreviation of titles: (*a*) the abbreviated title must be intelligible without a key; (*b*) in the abbreviated title the words, whether entire or abbreviated, must follow each other in the same order as in the original title; (*c*) titles of proceedings, reports, or scientific periodicals in general which are edited or published by learned societies, academies, etc., must, however, begin with the name of the place where the society resides; (*d*) in the case of other periodicals the name of the town where they are edited follows the abbreviated title. The regulations of the Consilium Bibliographicum contain the first two rules of the International Catalogue, but the names of towns are used only when necessary to avoid confusion. It would be a great convenience to readers of chemical works if a uniform system could be adopted, and it is to be hoped that Guye's suggestions will be carried out.

Engineering for May 8 gives particulars of the arrangements made at the Royal Air-craft Factory, Farnborough, for the aeroplane engine competition instituted by the British Government, and now proceeding. The engines are to be of British manufacture throughout (magneto excepted), and in view of the successful performances of British aeroplanes fitted with foreign engines, it is satisfactory to note that there has been a good entry, and that a large number of engines has actually been delivered for test. The test-house has been arranged with six test-beds and friction brakes, each contained in a separate cubicle, and supplied with a wind current of sixty miles an hour. The brakes are the latest pattern of Heenan and Froude's water dynamometer. The War Office proposes to publish a report at the conclusion of the trials.

THE new Cunard liner *Aquitania* was towed successfully from the Clydebank yard of Messrs. John Brown and Co., Ltd., to Greenock on Sunday, May 10. After her trial trips this week, she will proceed to Liverpool to be prepared for her maiden voyage to New York on May 30. *Engineering* for May 8 contains an illustrated article dealing with the propelling machinery of this ship. There are twenty-one cylindrical double-ended boilers, each having eight furnaces. The turbine machinery driving the four propeller shafts has been arranged to work on the triple system. The high-pressure ahead turbine, which, along with a high-pressure astern turbine, occupies a separate compartment on the port-wing turbine-room, receives boiler steam direct, which is passed in turn to the intermediate-pressure turbine, occupying, along with a high-pressure astern turbine, a similar compartment on the starboard wing. Two low-pressure ahead turbines on the two inner shafts receive their steam from the intermediate-pressure turbine. Some idea of the enormous size of these turbines may be obtained from the diameter of 15 ft. 4 in. over the tips of the blades of the low-pressure turbine. The combined weight of the low-pressure ahead and astern turbines on one shaft is 445 tons.

OUR ASTRONOMICAL COLUMN.

A REGISTERING MICROPHOTOMETER.—In 1912 Dr P. Paul Koch described a registering microphotometer designed by himself; the apparatus records photographically the varying intensities of a series of objects such as the lines in a spectrum or a set of interference rings and show their distance apart. The principle involved is to move the negative to be measured slowly in front of an opening through which a beam of light from a constant source is passed, and the resulting changes in the intensity of this light are recorded on a moving photographic plate. Dr. Koch now describes (Contributions from the Mount Wilson Solar Observatory, No. 77) an application of this instrument to the study of certain types of laboratory spectra, and displays in diagrams the resulting curves obtained. Thus, there are types of curves for furnace lines for different temperatures, for lines displaced by pressure, reversed lines, tube-arc lines, etc. While the observations described are stated to be only preliminary and very limited in scope, they are sufficient to indicate the usefulness of the instrument in those branches of spectroscopy in which it is desired to investigate quantitatively measures of line-intensity and structure.

VARIABLE STAR OBSERVATIONS.—No. iii. of the Publications of the Vassar College Observatory contains a most useful series of variable star observations made during the period 1901 to 1912, totalling in all 4797 observations. In the publication two points in particular have been aimed at, namely, first to reduce all magnitudes to a uniform standard, that of the Harvard photometry; and secondly, to give the original observations with the exact identification of the companion stars, in order that they may be reduced to any other desired photometric scale. In the introductory remarks, written by the present director, Caroline E. Furness, a detailed account is given of the instruments used, methods of observation employed, etc. Table I., which occupies the greater portion of the publication, gives the details of the observation of each variable; Table II. deals with some photometric observations; Table III. gives the magnitude on the Harvard photometric scale for every tenth grade of the Hagen, while the observed maxima and minima are compared with the ephemeris in Table IV.

ENHANCED MANGANESE LINES AND α ANDROMEDÆ.—The spectrum of α Andromedæ displays peculiarities which have rendered it difficult to couple it up with other stars in stellar classifications. Both the Harvard and the South Kensington classifications have indicated this star as an anomaly. The lines which are responsible for this peculiarity have now been run to earth by Mr. F. E. Baxandall, and he finds that in the main they are due to a form of manganese known as proto-manganese (Monthly Notices R.A.S., vol. 74, No. iii., p. 250). In his paper, Mr. Baxandall publishes three independent sets of measures of the stellar lines, and he states that while there is no proto manganese line which does not agree in position—within the limits of error in measurement—with an α Andromedæ line, this long succession of close agreements leaves little or no doubt that the two sets are identical. Attention is directed to the interesting fact that while in α Cygni and α Canis Majoris the enhanced lines of iron, chromium, and titanium are strongly shown, and the proto-manganese lines are comparatively weak or lacking, on the other hand, in α Andromedæ the case is the opposite. It will thus be seen that important criteria are being accumulated to help in the task of stellar classification, a former prominent case of another proto-substance being that of chromium in the spectrum of ϵ Ursæ Majoris shown at South Kensington.

THE CARNEGIE TRUST.[1]

THE Carnegie Trust for the Universities of Scotland has been in operation for twelve years, and it is now possible to draw some general conclusions as to the success which has attended its working. No other scheme for the endowment of higher education and research in this country has been planned on such a large scale as that indicated in the present report and its predecessors, and the progress of an experiment of such magnitude has been followed with interest by all who have to do with University affairs.

The financial statement for the year 1912–13 shows that the annual income of the trust amounts to rather more than 100,000*l*., and after defraying the expenses of administration there is left about 99,000*l*. as the net revenue available for distribution under the two main heads of the scheme. Half of this sum is earmarked annually for the payment of students' fees, while the other moiety is devoted (*a*) to the better equipment of the Scottish universities and colleges by the foundation of additional chairs and lectureships, and by the provision of new laboratories and permanent equipment, and (*b*) to the endowment of research. Of course, the equipment section of the expenditure also plays its part in the advancement of research work, as it furnishes places in which investigations can be carried on and also helps to provide posts for men who become directors of research in their various departments. It will be seen that the operations of the trustees are financially on a grand scale; for the funds at their disposal annually represent a sum equivalent to about 60 per cent. of the total Government grant in support of the higher educational institutions in England and Wales.

In the allocation of the funds, the trustees have been guided by two main considerations. First, they decided that their assistance to the four universities and their kindred colleges should be given under a quinquennial scheme, so that each step forward has been based upon the allocation of approximately half a million sterling. Secondly, a general rule was laid down that the trust would not hamper its income by paying salaries for new posts year by year out of the annual revenue, but instead, any new chair or lectureship is endowed fully at the start, so that its subsequent career entails no further draft upon the funds of the trustees. In this way, each chair on its foundation disappears from the books of the trust, and the next quinquennial distribution can be devoted to entirely fresh needs.

Any visitor to the Scottish universities in recent years must have been struck by the progress which has been made in the provision of new laboratories and departments of all kinds; buildings have sprung up until the older part of the fabric appears to be lost in the new. But buildings alone are of little value, and the influence of the trust is equally marked in the large increases of staff which have been rendered possible.

These, however, though they represent the major part of the trust's expenditure, are by no means the most striking monument which the trustees have raised, for their endowment of research and post-graduate study has been on an equally far-reaching scale. A system of scholarships and fellowships has been founded, which is supplemented by a series of grants in aid of research to Scottish graduates resident in Scotland; and this part of the trust's work has been of equal, if not greater, importance to the Scottish university system. Thus from the time a student enters the University to the day he leaves Scotland he finds a helping hand extended to him should he wish to grasp it.

[1] Twelfth Annual Report of the Carnegie Trust for the Universities of Scotland, 1912–13.

During his undergraduate career, he may obtain payment of his university fees; later, he may aspire to carry out researches, in which case he may apply for a scholarship or a fellowship. The research scholarships are conferred upon students on the recommendation of experts—usually the persons under whom the beginner in research will have to take his first steps in original work. Research fellowships are meant for men who have already accomplished something, and they are allocated on the merits of the work which the candidate has already published. In neither case is there any competitive examination, nor do the trustees bind themselves to furnish a fixed number of scholarships or fellowships in a given year. This is one of the most desirable features of their policy; for, as any teacher knows, an institution may turn out, say twenty first-class men in a given year, whilst in the following year only one or two may appear, so that the granting of a fixed number of scholarships per annum simply means that in some years a first-class man may not secure an appointment to a scholarship which in the following year will fall to the lot of a much inferior man owing to there being a dearth of candidates. It should be pointed out that the trustees retain all these appointments in their own hands, so that graduates of all the four universities are dealt with on equal terms. The scholarships are of the value of 100*l*. per annum, and are tenable for one year with a possibility of extension or of the holder's promotion to a fellowship; the fellowships are of the value of 150*l*. per annum, and are normally tenable for two years, though further renewals are possible.

The facts given in the report with regard to the subsequent careers of scholars and fellows go to prove that the research training they have undergone has fitted these men for the most varied appointments; and it must be remembered that the actual output of research work during the tenure of a scholarship or fellowship is not by any means the full index of the success of the scheme. Most of the men continue their investigations after they have severed their actual connection with the trust, and their later work must to some extent be placed to the credit of the trustees.

The impetus to research which has been produced by the work of the trust can be gauged from an example chosen from one science, chemistry. In the eight years 1903–11, the trust appointed in this department forty-five scholars, twenty-five fellows, and thirty-one grantees. The work of these has resulted in the publication of more than 130 original communications to scientific journals. Now, in 1912, the contributions of the whole British chemical world to the Transactions of the Chemical Society amounted to only double this number, 266, so that it is evident that the Carnegie Trust, by its encouragement of research, has indirectly in the course of eight years produced a series of results equal to half the annual output of the whole Empire at the present time. This, it must be remembered, represents only a single department of the trust's activities; for, in addition to chemistry, work is being carried out in physics, biology, medicine, economics, history, and languages.

One final point deserves note. In dealing with a machine of this magnitude, it is, of course, impossible to proceed without laying down some general rules; but the Carnegie Trustees have hitherto avoided the pitfall of too great rigidity, and the flexibility of their system is one of its most valuable features. There can be no doubt that Dr. Andrew Carnegie's experiment has resulted in brilliant success in the development of the research talent of his native country.

A. W. S.

LAWS OF ATMOSPHERIC MOVEMENTS.[1]

THE motion of the upper layers of the atmosphere is discussed in these two papers by Dr. W. N. Shaw, recently published. It is difficult in a short space to give a clear idea of the conclusions reached, but some of the main points may be here summarised.

In the paper published by the Scottish Meteorological Society it is shown that if p denote the pressure in millibars, and θ the absolute temperature (C.), and Δp and $\Delta\theta$ the changes that occur in passing horizontally from one place to another, then the rate of increase of pressure difference in millibars per metre of height is $0{\cdot}0342\ p/\theta\ (\Delta\theta/\theta - \Delta p/p)$. It is then shown that from about 1 km. to 9 km. the values of $\Delta\theta$ and Δp have in general the same sign, so that the term in brackets is small, and hence pressure differences, *i.e.* the barometric gradient, are maintained without much alteration up to 9 km. Above 10 or 11 km. $\Delta\theta$ and Δp have in general a different sign and the magnitude of the gradient rapidly falls off. The effect upon the wind at various altitudes is then considered, and special cases where simultaneous observations over England, Scotland, and Ireland are available are taken.

In the paper published by the Royal Society of Edinburgh, Dr. Shaw gives five axioms or laws of atmospheric motion, two lemmas or postulates, and six propositions. His first law reads thus :—

"In the upper layers of the atmosphere the steady horizontal motion of the air at any level is along the horizontal section of the isobaric surfaces at that level, and the velocity is inversely proportional to the separation of the isobaric lines in the level of the section."

The whole discussion turns upon the truth of this law, and Dr. Shaw confesses that observation is at present incapable of proving or of disproving it. There can be very little doubt that it is approximately true, for except near the equator pressure differences come into existence and persist for days or even weeks. These differences could not continue even for an hour if there were not some compensating horizontal acceleration acting on the air from the low towards the high pressure, for otherwise the inevitable rule which makes the surface of a liquid horizontal would come into play, and a depression would be filled up almost as soon as it was formed. Some opposing acceleration must therefore act whenever and wherever there is a barometric gradient, and we can conceive of no other possible source of this acceleration save that given in law I. But in the upper strata there must be a certain small amount of flow outward across the isobars from low to high pressure to compensate for the inverse flow that occurs close to the earth, where frictional resistances prevent the requisite velocity along the isobars from being attained. The other laws and the two lemmas will probably be accepted with the small reservations given by the author without demur.

The propositions follow from the laws and postulates. They are of great interest, but are too long to be quoted here. It will suffice to say that Dr. Shaw finds that a current flowing east or west will be stable, but a current flowing north or south is more or less unstable, and must lose or gain air as it goes. Also his suggestion about the flow of air up or down the land slopes from the interior of the continents to the sea is very pertinent, and, to my mind, affords a better explanation of the winter anticyclone over Asia and North America than that commonly given.

W. H. DINES.

[1] (1) "Upper Air Calculus and the British Soundings during the International Week (May 5–10), 1913." From the Journal of the Scottish Meteorological Society. Third series. Vol. xvi. No xxx.
(2) "Principia Atmospherica : a Study of the Circulation of the Atmosphere." (Proc. Roy. Soc. Edin., vol. xxxiv., 1914, pp. 77–112).

AN ELECTRICAL ANALOGY OF THE ZEEMAN EFFECT.

THE discovery, announced by J. Stark in NATURE of December 4, 1913, that when hydrogen in a state of luminescence is placed in an electric field of suitable strength and direction, the spectral lines are resolved into three or more components, is evidently a fact of prime physical importance. It will place in the hands of physicists another method of investigating the internal structure of the atom, and, in conjunction with the Zeeman effect, will no doubt be of immense service in the discovery of further regularities in spectral series, and in the attempts now being made by Bohr, Nicholson, and others to explain the origin of spectra on a dynamical basis. In this connection a series of papers in the *Rendiconti della R. Accad. dei Lincei* by Garbasso, Lo Surdo, and Puccianti will be of great interest to readers of NATURE.

The effect appears to have been observed independently by Lo Surdo whilst working on the retrograde positive rays in the neighbourhood of the kathode. An account of his first observations is given in a paper read on December 21, 1913. A cylindrical tube 20 cm. long and 4 mm. in diameter was used. It carried disc electrodes which completely filled the section, and it was excited by means of an accumulator battery. In these circumstances it was found that the electric field in the Crookes dark space was of itself sufficient to produce resolution of the lines. The observations were made with a four-prism quartz spectrograph. By suitable modifications the tube was varied so that the line of sight was either along or perpendicular to the field. The two outer components are polarised with the electric vector parallel to the field, the remainder in a perpendicular plane. When observations are made along the lines of force the outer components are missing. In a later paper, using a tube 1·5 mm. in diameter, Puccianti finds that the effect can readily be seen in the well-known Hilger wave-length spectroscope with constant deviation prism. The lines of the hydrogen spectrum show an interesting series of regularities; these are displayed in the following table (after Lo Surdo). Writing the Balmer formula in the form, $1/\lambda = a - 4a/n^2$, n has the values 3, 4, etc., for the different lines.

	H	H_β	H_γ	H_δ
n	3	4	5	6
Total no. of components	3	4	5	6
Order of line in the series	1st	2nd	3rd	4th
Component with electric vector $\perp$ to the field...	1	2	3	4
Appearance of resolved lines[1]				

It is seen that the number of components in a given line is the same as the corresponding value of n in the Balmer formula, and that the number of internal components is the same as the order of the given line in the spectral series. According to the measurements of Puccianti the separation of the outer components for H_β and H_α are in the ratio 1·49, or, expressed as fractions of the corresponding wave-lengths,

$$\frac{\delta_\beta}{\lambda_\beta} \Big/ \frac{\delta_\alpha}{\lambda_\alpha} = 2{\cdot}01$$

In a paper of December 21, 1913, Garbasso discusses the matter theoretically, to arrive at the conclusion that the Thomson model atom is incapable of explaining the (earlier) observations, except by the introduction of improbable hypotheses.

R. S. W.

[1] The components placed above have the vector parallel to the field.

RELATIONS BETWEEN THE SPECTRA AND OTHER CHARACTERISTICS OF THE STARS.*

III.

To proceed farther we must have recourse to the study of eclipsing variable stars. Methods for computing their orbits have been developed at Princeton during the last few years,[20] the main motive for the investigation being the astrophysical importance of the results. Dr. Shapley, using the methods devised by the speaker, has obtained elements for eighty-seven such systems,[21] for each one of which the density of the components may be calculated. The values here employed are those which result from the assumption that the stars present discs darkened toward the edge, like the sun, but to a still higher degree, and the principal uncertainty of the results (which in any case cannot be very serious) arises from our present ignorance of the actual degree of this darkening. For our present purpose, they may be best utilised by computing the absolute magnitudes which the brighter component of each system would have if its mass and surface brightness were equal to those of the sun, leaving outstanding the differences due to density alone.

The results for the eighty eclipsing variable the elements and spectra of which are known are plotted in Fig. 4, on the same system as in the preceding figures. The black dots represent those stars for which the photometric data are most trustworthy, the open circles those of less precision. We are once more greatly indebted to Prof. Pickering and Miss Cannon for information regarding the spectra of these stars. To the absolute magnitude 4·0 on this diagram corresponds a density 1/3 that of the sun; to 3·0, 1/11; to 2·0, 1/45; to 1·0, 1/180 of the sun's density, and so on.

FIG. 4.

This diagram bears at first sight but small resemblance to the previous ones, but a little study brings out several important things. First, though the majority of these eclipsing variables are of Class A, every class from B to K is represented, and there are eight stars of Class G or redder. Secondly, all but one of these eighty stars are less dense than the sun, though but few of them are of less than 1/100 the sun's density. Thirdly, the stars of Classes A and B are fairly similar to one another in density, the great majority having densities between 1/3 and 1/45 of the sun's; those of Class F show a compact group of high density, and an isolated star of low density; but in Classes G and K the range of density is enormously great—from nearly twice that of the sun (W Ursæ Majoris) to one-millionth of the sun's density (W Crucis, at the top of the diagram). Fourthly, among the stars of density less than 1/200 that of the sun (corresponding to about +1·om. on the diagram), only one of the seventy-one stars of Classes B to F appears, while four of the eight stars

* An address delivered before a joint meeting of the Astronomical and Astrophysical Society of America and Section A of the American Association for the Advancement of Science, at Atlanta, Georgia, December 30, 1913, with a few additions, by Prof. H. N. Russell. Continued from p. 258.

[20] *Astrophys Jour.*, vol. xxxv., p. 315, and vol. xxxvi., pp. 54, 239, 385, 1912.

[21] *Astrophys. Jour.*, vol. xxxviii., pp. 159–73, 1913.

of Classes G and K are included. We may now answer decisively, and in the affirmative, the first two questions which were put a few moments ago. Some stars actually have densities quite as low as any that might be required to explain the great brightness of the reddest giant stars; and these stars of low density show a very marked preference for the "later" spectral classes, while practically all the stars of "earlier" type are far denser.

We can answer the third question as well, and in a quantitative fashion, if we are willing to assume that the eclipsing binaries, and also the telescopic double stars, of the various spectral classes are typical of the stars of these classes as a whole. Though this may not be rigorously true, there is good reason to believe that it is not seriously in error. We find, from Fig. 4, that the fifty eclipsing stars of Class A, if they all had the sun's mass and surface brightness, but their own densities, would, on the average, be of the absolute magnitude 3·06. Now, referring to Fig. 3, we find that the mean absolute magnitude which the 115 visual double stars of Class AO there recorded would have, if they were equal in mass only to the sun, but had their own surface brightness as well as density, would be 1·07. The only difference between these two groups (if they are both typical of the stars of Class A in general) is that one has been reduced by computation to the sun's surface brightness, while the other has not. It is therefore evident that the stars of Class A must, on the average, for equal surfaces, be two magnitudes brighter than the sun. Apart from the uncertainty whether the two groups compared are exactly typical, the probable error of this determination should be less than one-tenth of a magnitude.

In similar fashion, we find that the mean absolute magnitude of fifty-two visual pairs of spectra Oe5 to B9, reduced to the sun's mass, is −0·4, while that of twelve eclipsing binaries of similar spectrum, reduced to the sun's mass, and surface brightness, is +2·8, which makes the surface brightness of an average star of Class B greater by 3·2m. than that of the sun. Again, for the stars of Class F, we get +2·6 for the mean reduced absolute magnitude of the sixty-nine visual pairs, and +3·7 for that of the nine eclipsing pairs, the difference of 1·1m. being approximately the effect of surface brightness (somewhat more uncertain here, on account of the apparently different proportion of giant stars in the two groups).

It appears, therefore, that in passing down the spectral series from B to G, the surface brightness of the stars decreases by about one magnitude from each class to the next; and we have previously found that, among the dwarf stars, the decrease in surface brightness in passing from G to M must be at least 2½ magnitudes more. All this has been shown without making any use whatever of the physical meaning of the spectra, which have simply been used as symbols in classifying the stars into groups. The results are obviously in accordance with the view that the differences of spectral type arise from differences of temperature. Indeed, they constitute new and important evidence in its favour. How well they agree with other independent lines of evidence is shown by comparing the relative surface brightness just computed with the colour-index for the various classes. Taking A as a standard, we have:—

Spectrum	B	A	F	G	K	M
Surface brightness	−1·2	0·0	+0·9	+2·0	—	+4·5 (at least)
Colour-index ...	−0·3	0·0	+0·3	+0·7	+1·2	+1·6

The computed differences in surface brightness are in all cases about three times the colour-indices, in good agreement with the theoretical ratio.

We may now estimate the density of the redder giant stars. It appears from Fig. 3 that the mean absolute magnitude of the giant stars, if reduced to the sun's mass, is +0·6 for Class G, +0·5 for Class K, and 0·0 for Classes K5 and M. The differences between these values are small, and we may well take the general mean, +0·44, as typical of the whole. This corresponds to about fifty times the sun's luminosity. Such a giant star of Class G, if of the sun's surface brightness, would have to be of about seven times the sun's radius, and of 1/350 of its density. If we assume, on the basis of the foregoing study of the dwarf stars, that the surface intensities of the giant stars of Classes K and M are respectively 1·5 and 3 magnitudes fainter than that of the sun, we find that their densities must be 1/2800 and 1/25,000 of the sun's density. The observed densities of several eclipsing variables of Classes G and K are of just the order of magnitude here found, so that there is direct observational evidence in favour of all our conclusions, except the very low density assigned to the giant stars of Class M (among which no eclipsing variables have yet been found, so that their densities cannot be directly determined). But there is nothing improbable about so low a density, for we know of at least one star—W Crucis—the density of which is still smaller.

Before leaving these diagrams we should notice that, by comparing the data of Fig. 3 with those of Figs. 1 and 2, we may obtain the average masses of the stars of the various types. Consider, for example, the stars of spectra B to B5. From Fig. 3 we see that, if these stars were reduced to the sun's mass without changing either their surface brightness or density, their mean absolute magnitude would be −0·6. But the actual mean absolute magnitude of the stars of this spectral class is −2·0 according to Campbell, or −0·8 according to Boss. Taking the mean of these determinations, we find that these stars are, on the average, 2·1 times as bright as stars of unit mass, but of the same surface brightness and density, would be, from which it follows that their average surface area must be 2·1 times that of the latter stars, and their average mass 3·0 times that of the sun. The uncertainty whether the groups of stars which we are comparing are really exactly similar is here more serious than usual; if Campbell's stars are taken as typical, the mean mass comes out seven times that of the sun. It should be noticed that the "average" mass here obtained corresponds approximately to the average of the logarithms of the individual masses, and hence to their geometrical mean, which will be somewhat smaller than their arithmetical mean, and that we are here dealing with the mass of the brighter component of each system only. For the twelve spectroscopic binaries of spectrum B, which are available for comparison, the mean mass of the brighter components is about 9, and the geometrical mean probably about 7·5, times the sun's mass. As the observational selection in this case undoubtedly favours the larger masses, there is no serious discrepancy between the two results.

Proceeding similarly for the stars of the other spectral classes, we obtain the results collected in Table VII. The observed absolute magnitudes of the stars in clusters have been taken in preference to those of the stars of directly measured parallax, for the reasons already stated, and for the giant stars the mean of the results of Boss and Campbell has been used (except for Class G, for which Boss's value alone really represents them).

TABLE VII.

Mean Masses of Bright Components of Double Stars.

Spectrum	Observed absolute mag.	Abs. mag. reduced to sun's mass	Resulting average mass
B2	−1·4	−0·6	3·0
A0	+0·5	+1·1	2·3
A5, dwarf	+1·5	+1·6	1·2
F0 ,, ...	+2·4	+2·8	1·7
F3 ,, ...	+3·3	+3·1	0·8
F8 and G0 ...	+4·8	+4·0	0·5
G5, dwarf	+5·1	+4·2	0·3
K0 ,, ...	+6·4	+5·5	0·3
K5 and M, dwarf	+8·9	+7·7	0·2
G and G5, giant	−0·2	+0·6	3·0
K0, giant ...	+0·2	+0·5	1·5
K5 and M, giant	−0·3	0·0	1·5

The general similarity in mass among the stars of such widely different characteristics is very striking. In view of the small numbers of stars in some of the groups, the differences between the individual values should not be greatly stressed, but the gradual decrease of average mass among the dwarf stars is in accordance with the results of direct measurement. The geometrical mean of the computed masses of the bright components of the eight visual binaries of spectra A to F5, the parallaxes of which have been determined with tolerable accuracy, is 1·8 times the sun's mass; for the ten similar stars of spectra F8 to K it is 0·8. The greater mass of the stars of Class B is scarcely shown by these figures, but on this matter the testimony of the spectroscopic binaries deserves much the greater weight. The important conclusion which may be drawn from Table VII. is that, although the range in mean luminosity among the various groups of stars exceeds ten-thousandfold, the range in the mean masses probably does not exceed twenty-, or at most thirty-fold.

We may now summarise the facts which have been brought to light, as follows:—

(1) The differences in brightness between the stars of different spectral classes, and between the giant and dwarf stars of the same class, do not arise (directly at least) from differences in mass. Indeed, the mean masses of the various groups of stars are extraordinarily similar.

(2) The surface brightness of the stars diminishes rapidly with increasing redness, changing by about three times the difference in colour-index, or rather more than one magnitude, from each class to the next.

(3) The mean density of the stars of Classes B and A is a little more than one-tenth that of the sun. The densities of the dwarf stars increase with increasing redness from this value through that of the sun to a limit which cannot at present be exactly defined. This increase in density, together with the diminution in surface brightness, accounts for the rapid fall in luminosity with increasing redness among these stars.

(4) The mean densities of the giant stars diminish rapidly with increasing redness, from one-tenth that of the sun for Class A to less than one twenty-thousandth that of the sun for Class M. This counteracts the change in surface brightness, and explains the approximate equality in luminosity of all these stars.

(5) The actual existence of stars of spectra G and K, the densities of which are of the order here derived, is proved by several examples among the eclipsing variables, all of which are far less dense than any one of the more numerous eclipsing stars of "early" spectral type, with the sole exception of β Lyræ.

Evolution.

These facts have evidently a decided bearing on the problem of stellar evolution, and I will ask your indulgence during the few minutes which remain for an outline of the theory of development to which it appears to me that they must inevitably lead.

Of all the propositions, more or less debatable, which may be made regarding stellar evolution, there is probably none that would command more general acceptance than this—that as a star grows older it contracts. Indeed, since contraction converts potential energy of gravitation into heat, which is transferred by radiation to cooler bodies, it appears from thermodynamic principles that the general trend of change must, in the long run, be in this direction. It is conceivable that at some particular epoch in a star's history there might be so rapid an evolution of energy—for example, of a radio-active nature—that it temporarily surpassed the loss by radiation and led to an expansion against gravity; but this would be, at most, a passing stage in its career, and it would still be true in the long run that the order of increasing density is the order of advancing evolution.

If, now, we arrange the stars which we have been studying in such an order, we must begin with the giant stars of Class M, follow the series of giant stars, in the reverse order from that in which the spectra are usually placed, up to A and B, and then, still with increasing density, though at a slower rate, proceed down the series of dwarf stars, in the usual order of the spectral classes, past the sun, to those red stars (again of Class M), which are the faintest at present known. There can be no doubt at all that this is the order of increasing density; if it is also the order of advancing age, we are led at once back to Lockyer's hypothesis that a star is hottest near the middle of its history, and that the redder stars fall into two groups, one of rising and the other of falling temperature.[22] The giant stars then represent successive stages in the heating up of a body, and must be more primitive the redder they are; the dwarf stars represent successive stages in its later cooling, and the reddest of these are the farthest advanced. We have no longer two separate series to deal with, but a single one, beginning and ending with Class M, and with Class B in the middle, all the intervening classes being represented, in inverse order, in each half of the sequence.

The great majority of the stars visible to the naked eye, except perhaps in Class F, are giants; hence for most of these stars the order of evolution is the reverse of that now generally assumed, and the terms "early" and "late" applied to the corresponding spectral types are actually misleading.

This is a revolutionary conclusion; but, so far as I can see, we are simply shut up to it, with no reasonable escape. If stars of the type of Capella, γ Andromedæ, and Antares represent later stages of development of bodies such as δ Orionis, α Virginis and Algol, we must admit that, as they grew older and lost energy, they have expanded, in the teeth of gravitation, to many times their original diameters, and have diminished many hundred-, or even thousand-fold in density. For the same reason we cannot regard the giant stars of Class K as later stages of those of Class G, or those of Class M as later stages of either of the others, unless we are ready to admit that they have expanded against gravity in a similar fashion. We may, of course, take refuge in the belief that the giant stars of the

22 Phil. Trans., vol. clxxxiv., p. 688, 1902; Proc. Roy. Soc., vol. lxv., p. 186, 1899.

various spectral classes have no genetic relations with one another—that no one class among them represents any stage in the evolution of stars like any of the others—but this is to deny the possibility of forming any general scheme of evolution at all.

We might be driven to some such counsel of despair if the scheme suggested by the observed facts should prove physically impossible; but, as a matter of fact, it is in conspicuous agreement with the conclusions which may be reached directly from elementary and very probable physical considerations.

There can be very little doubt that the stars, in general, are masses of gas, and that the great majority of them, at least, are at any given moment very approximately in stable internal equilibrium under the influence of their own gravitation, and very nearly in a steady state as regards the production and radiation of heat, but are slowly contracting on account of their loss of energy. Much has been written upon the behaviour of such a mass of gas by Lane, Ritter, and several later investigators,[23] and many of their conclusions are well established and well known. So long as the density of the gaseous mass remains so low that the ordinary "gas laws" represent its behaviour with tolerable accuracy, and so long as it remains built upon the same model (*i.e.*, so long as the density and temperature at geometrically homologous points vary proportionally to the central density or temperature), the central temperature (and hence that at any series of homologous points) will vary inversely as the radius. This is often called Lane's law. If, after the contraction, the star is built only approximately on the same model as before, this law will be approximately, but not exactly, true.

The temperature of the layers from which the bulk of the emitted radiation comes will also rise as the star contracts, but more slowly, since the increase in density will make the gas effectively opaque in a layer the thickness of which is an ever-decreasing fraction of the radius. The temperature of the outer, nearly transparent gases, in which the line absorption takes place, will be determined almost entirely by the energy density of the flux of radiation through them from the layers below—that is, by the "black-body" temperature corresponding to this radiation as observed at a distance.

As the gaseous mass slowly loses energy and contracts, its effective temperature will rise, its light will grow whiter, and its surface brightness increase, while corresponding modifications will occur in the line absorption in its spectrum. Meanwhile, its diameter and surface will diminish, and this will at least partially counteract the influence of the increased surface brightness, and may even overbalance it. It cannot therefore be stated, without further knowledge, in which direction the whole amount of light emitted by the body will change.

This process will go on until the gas reaches such a density that the departures of its behaviour from the simple laws which hold true for a perfect gas become important. Such a density will be first reached at the centre of the mass. At the high temperatures with which we are dealing, the principal departure from the simple gas laws will be that the gas becomes more difficultly compressible, so that a smaller rise in temperature than that demanded by the elementary theory will suffice to preserve equilibrium after further contraction. The rise in temperature will therefore slacken, and finally cease, first at the centre, and later in the outer layers. Further contraction will only be possible if accompanied by a fall of temperature, and the heat expended in warming the mass during the earlier stages will now be gradually transmitted to the surface and liberated by radiation, along with that generated by the contraction. During this stage, the behaviour of the mass will resemble, roughly, that of a cooling solid body, though the rate of decrease of temperature will be far slower. The diameter and surface brightness will now both diminish, and the luminosity of the mass will fall off very rapidly as its light grows redder. It will always be much less than the luminosity of the body when it reached the same temperature while growing hotter, on account of the contraction which has taken place in the interval, and this difference of luminosity will be greater the lower the temperature selected for the comparison. Sooner or later, the mass must liquefy, and then solidify (if of composition similar to the stellar atmospheres), and at the end it will be cold and dark; but these changes will not begin, except perhaps for a few minor constituents of very high boiling point, until the surface temperature has fallen far below that of the stars of Class M (about 3000° C.).

The "critical density" at which the rise of temperature will cease can only be roughly estimated. It must certainly be much greater than that of ordinary air, and (at least for substances of moderate molecular weight), considerably less than that of water. Lord Kelvin,[24] a few years ago, expressed his agreement with a statement of Prof. Perry's that "speculation on this basis of perfectly gaseous stuff ought to cease when the density of the gas at the centre of the star approaches one-tenth of the density of ordinary water in the laboratory."

It is clear from the context that this refers rather to the beginning of sensible departures from Lane's law than to the actual attainment of the maximum temperature, which would come later; and it seems probable, from the considerations already mentioned, that the maximum temperature of the surface would be attained at a somewhat higher density than the maximum central temperature.

The resemblance between the characteristics that might thus be theoretically anticipated in a mass of gas of stellar dimensions, during the course of its contraction, and the actual characteristics of the series of giant and dwarf stars of the various spectral classes is so close that it might fairly be described as identical. The compensating influences of variations in density and surface brightness, which keep all the giant stars nearly equal in luminosity, the rapid fall of brightness among the dwarf stars, and the ever-increasing difference between the two classes, with increasing redness, are all just what might be expected. More striking still is the entire agreement between the actual densities of the stars of the various sorts and those estimated for bodies in the different stages of development, on the basis of the general properties of gaseous matter. The densities found observationally for the giant stars of Classes G to M are such that Lane's law must apply to them, and they must grow hotter if they contract; that of the sun (a typical dwarf star) is so high that the reverse must almost certainly be true; and the mean density of the stars of Classes B and A (about one-ninth that of the sun, or one-sixth that of water) is just of the order of magnitude at which a contracting mass of gas might be expected to reach its highest surface temperature.

We may carry our reasoning farther. Another deduction from the elementary theory (as easily proved as Lane's law, but less generally known) is that, in two masses of perfect gas, similarly constituted and of equal radius, the temperatures at homologous points are directly proportional to their masses. As in the previous case, the effective surface temperature of the

[23] An excellent summary may be found in Emden's *Gaskugeln*.

[24] NATURE, vol. lxxv., p. 368, 1907.

more massive body will be the greater, though to a less degree than the central temperature. A large mass of gas will therefore arrive at a higher maximum temperature, upon reaching its critical density, than a small one. The highest temperatures will be attained only by the most massive bodies, and all through their career these will reach any given temperature at a lower density, on the ascent, and return to it at a higher density, on the descending scale, than a less massive body. They will therefore be of much greater luminosity, for the same temperature, than bodies of small mass if both are rising toward their maximum temperatures. On the descending side the difference will be less conspicuous. Bodies of very small mass will reach only a low temperature at maximum, which may not be sufficient to enable them to shine at all.

All this, again, is in excellent agreement with the observed facts. The hottest stars—those of Class B—are, on the average, decidedly more massive than those of any other spectral type. On the present theory, this is no mere chance, but the large masses are the necessary condition—one might almost say the cause—of the attainment of unusually high temperature. Only these stars would pass through the whole series of the spectral classes, from M to B and back again, in the course of their evolution. Less massive bodies would not reach a higher temperature than that corresponding to a spectrum of Class A; those still less massive would not get above Class F, and so on. This steady addition of stars of smaller and smaller mass, as we proceed down the spectral series, would lower the average mass of all the stars of a given spectral class with "advancing" type, in the case of the giants as well as that of the dwarfs. This change is conspicuously shown among the dwarf stars in Table VII., and faintly indicated among the giant stars. The average masses of the giant and dwarf stars appear, however, to be conspicuously different, which at first sight seems inconsistent with the theory that they represent different stages in the evolution of the same masses. But the giant stars which appear in these lists have been picked out in a way that greatly favours those of high luminosity, and hence, as we have seen, those of large mass, while this is not the case among the dwarf stars. The observed differences between them are therefore in agreement with our theory, and form an additional confirmation of it.

It is now easy, too, to understand why there is no evidence of the existence of luminous stars of mass less than one-tenth that of the sun. Smaller bodies presumably do not rise, even at maximum, to a temperature high enough to enable them to shine perceptibly (from the stellar point of view), and hence we do not see them. The fact that Jupiter and Saturn are dark, though of a density comparable with that of many of the dwarf stars, confirms this view.[25]

We may once more follow the lead of our hypothesis into a region which, so far as I know, has been previously practically untrodden by theory. It is well known that the great majority of the stars in any given region of space are fainter than the sun, and that there is a steady and rapid decrease in the number of stars per unit volume, with increasing luminosity. The dwarf stars, especially the fainter and redder ones, really greatly outnumber the giants, the preponderance of which in our catalogues arises entirely from the egregious preference given them by the inevitable method of selection by apparent brightness.

What should we expect to find theoretically? To get an answer, we must make one reasonable assumption, namely, that the number of stars, in any sufficiently large region of space, which is, at the present time, in any given stage of evolution, will be (roughly at least) proportional to the lengths of time which it takes a star to pass through the respective stages.[26] While a star is growing hotter it is large and bright, is radiating energy rapidly, and is also storing up heat in its interior; while, on account of its low density, contraction by a given percentage of its radius liberates a relatively small amount of gravitational energy. It will therefore pass through these stages with relative rapidity. Its passage through its maximum temperature will obviously be somewhat slower. During the cooling stages its surface is relatively small and its rate of radiation slow; it is dense, and a given percentage of contraction liberates a large amount of energy, and the great store of heat earlier accumulated in its interior is coming out again. It must therefore remain in these stages for very much longer intervals of time, especially in the later ones, when the rate of radiation is very small.

This reproduces, in its general outlines, just what is observed—the relative rarity of giant stars, the somewhat greater abundance of those of Class A near the maximum of temperature, and the rapidly increasing numbers of dwarf stars of smaller and smaller brightness. The well-known scarcity of stars of Class B, per unit of volume, is further accounted for if we believe, as has been already explained, that only the most massive stars reach this stage.

In this connection we will very probably be asked, What precedes or follows Class M in the proposed evolutionary series, and why do we not see stars in still earlier or later stages? With regard to the latter, it is obvious that dwarf stars still fainter than the faintest so far observed (which are of Class M) would, even if among our very nearest neighbours, be apparently fainter than the tenth magnitude. We cannot hope to find such stars until a systematic search has been made for very large proper-motions among very faint stars. The extreme redness of such stars would, unfortunately, render such a search by photographic methods less profitable than in most cases.

But a giant star of Class M, a hundred times as bright as the sun, certainly cannot spring into existence out of darkness. In its earlier stages it must have radiated a large amount of energy, though perhaps less than at present. But as the temperature of a radiating body falls below 3000° C., the energy-maximum in its spectrum moves far into the infra-red, leaving but a beggarly fraction of the whole radiation in the visible region. Stars in such stages

[25] In the foregoing presentation of the theory, to avoid interference with the progress of the main argument, no mention has been made of certain considerations which should be discussed here.

(1) It is probable that at stellar temperatures the gaseous matter is very considerably dissociated and ionised. But this will not affect its gaseous nature. For our present purpose it amounts to little more than a diminution of the mean molecular weight. This will lower the temperature corresponding to a given density and pressure, and so tend to lower the maximum attainable temperature; but as the degree of dissociation is likely to vary gradually with the temperature, it should not affect the orderly sequence of changes which form the basis of the previous arguments.

(2) It is also probable that the available potential energy of a star is not entirely gravitational, but partly, if not mainly, of radio-active or similar atomic origin. If, as in the relatively very small range accessible to experimental investigation, the rate of liberation of this energy is independent of the temperature and pressure, it would simply supply a constant annual addition to the energy derived from gravitational contraction, and the only difference in the course of events would be that a star, on cooling, would approach, not complete extinction, but a steady state, of very long duration, in which as much energy was annually radiated away as was supplied by atomic disintegration. If the rate of disintegration is increased under the extremely violent molecular collisions which must occur in the interior of a star, a great liberation of energy may occur when the interior has got hot enough, thus increasing the maxima temperature and prolonging its duration. But, even on this hypothesis, the number of the violent collisions which liberate the atomic energy would increase gradually as the temperature of the interior rose, and the general character of the evolutionary changes, including the relation of the mass and density of the body to the time of their occurrence, would not be radically altered.

It seems, therefore, probable that the previous reasoning would require no essential modification on account of either of these factors in the problem.

[26] Hertzsprung, *Zeitschrift für Wissenschaftliche Photographie*, vol. iii, p. 442, 1905.

would therefore emit much less light than they would do later, and stand a poor chance of being seen.[27] We know, as yet, very little about the colour-index and temperature of stars of those varieties of Class M (Mb and Mc) which are evidently furthest along in the spectral series, and it may well be that a star usually reaches the temperature corresponding to these stages by the time that it begins to shine at all brightly. In any case, stars in these very early stages should be of small or moderate luminosity, and rare per unit of volume, and hence very few of them would be included in our catalogues.

The great luminosity and extreme redness of the stars of Class N suggest that they belong at the beginning of the series of giant stars; but the relations of this very distinct spectral type to the others are not yet quite clear, and it would be premature to give it a definitive place in the sequence. It seems clear, however, that these stars must be in a very primitive condition, rather than in a very late one, as believed by Lockyer. The stars of Class O (Wolf-Rayet stars) are of very great average luminosity, and probably lie beyond those of Class B at the apex of the temperature scale, as Lockyer supposes. But in the absence of data concerning their masses, densities, and the like, we cannot place them definitively, except that Oe5 and Oe come almost certainly just above Be.

One further application of the theory may be very briefly mentioned. If we have a large number of contracting masses of gas endowed with various moments of momentum, more and more of them will split up into pairs as they grow denser, and the pairs latest formed will have the shortest periods. A large percentage of spectroscopic binaries, especially of short period, is therefore direct evidence of a fairly advanced state of evolution, and the occurrence of this condition among the stars of Classes B and A supports—indeed, almost by itself compels—the view that they are far removed from a primitive condition. Most of the stars which have been investigated for radial velocity are giants, and the absence of spectroscopic binaries of short period among the redder stars is in agreement with the view that they are in earlier stages of evolution.

The distribution of the visual binaries and physical pairs among the various spectral classes depends mainly upon a quite different factor, namely, the resolving power of our telescopes, which allows us to separate the closer pairs of short period only among the nearer stars, so that the systems for which orbits have been determined are nearly all dwarf stars.

I have endeavoured in the past hour to set before you the present state of knowledge concerning the real brightness, masses, densities, temperatures, and surface brightness of the stars, and to sketch the theory of stellar evolution to which the study of these things has led me. This theory is inconsistent with the generally accepted view. Its fundamental principle is identical with that of Lockyer's classification, but it differs radically from the latter in the principles according to which it assigns individual stars, and even whole classes of stars, to the series of ascending or descending temperature. (For example, Lockyer puts such conspicuously giant stars as Canopus, Capella, Arcturus, and β Cygni, and all the stars of Class N, into the descending series, and places β Hydri and δ Pavonis (which are clearly dwarf stars) in the ascending series.)

Two things have gone farthest to convince me that it may be a good approximation to the truth—the way in which it explains and coordinates characteristics of the different spectral types which previously appeared to be without connection or reason, and the way in which a number of apparent exceptions to its indications have disappeared, one by one, as more accurate information concerning spectra, orbits of double stars, and the like, became available, until only one doubtful case remains.

I have purposely made no attempt at this time to touch upon certain other interesting matters, such as the difference of the mean peculiar velocities of stars of the various spectral classes, although, with the aid of simple and very reasonable assumptions, they may be added to the list of things explainable by the new theory. My reason for this has been less for lack of time than because there is at present no definite reason, assignable from general considerations in advance, why we should expect an old star to be moving faster or slower than a younger one, while there is such a reason why we should suppose that a dense star is in a later stage of evolution than one of low density. It seems better to find out what we can about the order of evolution from data of the latter kind, and then apply our results to the study of problems of the former sort, than to attack them without such aid or by means of unproved assumptions. The assumptions that are necessary on the new theory are simple and probable enough, but they do not form an integral part of the theory, and cannot be established directly from general considerations, and so I will not discuss them now.

The new theory will not explain everything about the stars—I should be rather afraid of it if it did; for example, it leaves the phenomena of preferential motion, or "star-streaming," as puzzling as ever. I have only tried to interpret some of the facts most obviously capable of evolutionary explanation, on the fundamental assumption that the properties of matter, and the forces in operation, among the stars, are the same as those with which we are familiar in the laboratory. He would be a bold man indeed who would assert that this assumption is entirely true, but it seems clear that it should be thoroughly tried out before the existence of new forces can legitimately be postulated.

If the ideas to which you have so kindly listened to-day shall prove of any help toward removing the need for belief in unknown forces, and extending the domain of those already known, my labour will be far more than repaid; but it should not be forgotten that the real labourers have been those who, through long and weary nights, accumulated bit by bit, and, through monotonous days, prepared for the use of others the treasures of observational knowledge with which it has been my pleasurable lot to play in the comfort of my study.

I need scarcely add that, if what I have said proves of interest to any of you, your frank and unsparing criticism will be the greatest service which you can render me.

27 Russell, *Science*, N.S. Vol xxxvii, p. 646, 1913.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—At its last meeting the University council passed the following resolution:—"That the council desires to record its deep sorrow at the death of Prof. Poynting, who so faithfully served the Mason College and the University for thirty-four years. During his distinguished career as professor of physics he was not only an inspiring teacher and investigator, but bore a considerable part in the development of the college and of the University. His keen interest in all that concerned the University, its staff, and its students, his genial and attractive personality, will be long and affectionately remembered; his death leaves a gap which it will be most difficult to fill."

Mr. Frank E. Huxley has resigned his lectureship in dental surgery.

Dr. L. G. Parsons has been appointed assistant to the chair of forensic medicine and toxicology.

A full-time lectureship in classics, ancient history, and archæology is being established.

Miss M. Le Bour has been appointed to undertake a special investigation in helminthology in the department of agricultural zoology.

CAMBRIDGE.—Mr. E. R. Burdon has been appointed University lecturer in forestry.

The Anthony Wilkin studentship in ethnology and archæology will be available at the end of the Easter term. Applicants should send their names, qualifications, and a statement of the research which they wish to undertake, to the Vice-Chancellor before June 1.

Mr. H. C. Haslam, of Gonville and Caius College, has been approved by the General Board of Studies for the degree of Doctor of Science.

THE governors of the South Wales and Monmouthshire University College at Cardiff have accepted the generous offer of an anonymous donor to provide funds for the erection of a great school of preventive medicine. The money value of this gift, together with that of Sir William James Thomas to erect a school for other branches of medicine in connection with the college, is estimated at 180,000*l.*

Two lectures entitled "La Catalyse et mes divers Travaux sur la Catalyse," will be given by Prof. Paul Sabatier, of the University of Toulouse, at King's College, W.C., on May 14 and 15, at 5 p.m. Special interest is attached to these lectures as the subject-matter is one with which Prof. Sabatier is particularly associated, and one from which he has obtained important results in the synthetical preparation of organic substances.

IT is announced in the issue of *Science* for May 1 that the Catholic University of America, Washington, will receive the greater part of the estate of 200,000*l.* left by the late Mr. Theodore B. Basselin, of Croghan. From the same source we learn that Mr. James Deering, in a letter addressed to the trustees of North-western University and of Wesley Hospital, announces a gift of 200,000*l.* to the hospital. It is provided that Wesley Hospital shall be a teaching hospital under Northwestern University. The gift is made in honour of the donor's father and of his sister.

PROF. SIMS WOODHEAD, in his presidential address to the Royal Microscopical Society (Jour. Roy. Microscop. Soc., 1914, part 2, p. 109), suggests that too little attention is paid in our medical schools to the education of the students in the *technical* use of the microscope. He urges that there should be sound teaching on the optical and mechanical principles on which are based the construction and use of the microscope, and that the best students, at any rate, should have some opportunity of acquiring facility in the use of the various types of substage condenser, dark-ground illumination, monochromatic illumination, methods of measurement, ultra-microscopic work, micro-spectroscopy, polarisation, and the like.

FREE vacation courses in scientific instrument-making and glass-blowing will again be held this year at the University of Leyden. The course in instrument-making will include practice with modern machine tools, such as lathes, milling machines, etc., and will extend from August 20 to August 29; it will involve the cutting of screw threads, turning spheres, copying divided discs, and grinding various hardened objects. The course on elementary and advanced glass-blowing, from August 20 to September 2, will include the manufacture of vacuum tubes, vacuum flasks, and various other forms of apparatus used in physical and chemical investigation, and the manipulation of high-vacua pumps. The director of the course is Prof. Kamerlingh Onnes, and the secretary Dr. C. A. Crommelin, to whom all communications should be addressed at the Physical Laboratory, Leyden, Holland.

THE Medical Officers of Schools Association from time to time issues pamphlets on problems connected with conditions of health in schools. The latest of these useful publications deals with "School Lighting," and is a reprint of a paper read before the association by Dr. E. H. T. Nash. The author puts the difficulties of the problem of daylight illumination, and rightly asks that the Government should either subsidise further research or conduct a thorough inquiry through the Board of Education. In the present regulations of the Board we read: "The light so far as possible should be admitted from the left side of the scholars. This rule will be found greatly to influence the planning." So far all authorities agree, but there is great diversity of opinion and practice as regards bilateral and overhead lighting, the shape of class-rooms, the relative areas to be assigned to windows. These matters have an important influence on the health of the children, the class-room efficiency, and the expenditure of public money on school buildings. As regards artificial lighting, the problem is vastly more simple, and Dr. Nash gives an instance of efficient and economic lighting by incandescent gas, the cost for a class-room being rather more than $\frac{3}{4}d.$ an hour. In this case the illumination at the desks ranged from 3·5 foot-candles to 5 foot-candles, as compared with the usually recommended minimum of 2 foot-candles. The pamphlet is illustrated with diagrams, includes an account of the discussion which followed the reading of the paper, and is published by Messrs. Churchill at 1*s.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 7.—Sir William Crookes, president, in the chair.—Lord **Rayleigh**: (1) Some calculations in illustration of Fourier's theorem. (2) The theory of long waves and bores.—Sir Joseph **Larmor** and J. S. B. **Larmor**: Protection from lightning and the range of protection afforded by lightning rods. On modern ionic views discharge in the atmosphere should originate at a place of maximum intensity of electric field and spread both ways from it along a line which should be roughly the line of force. The explanation of branching, zigzag, and multiple lightning discharges is to be sought on these lines. The introduction of a narrow linear conductor cannot sensibly disturb a steady field of force, and not at all if it is transverse to the field. Thus it would seem to be the top of the building itself, not of the lightning conductor, that attracts the discharge, and the function of a single rod can only be to lead it more safely away. But a number of rods distributed over the area of the roof, and effectively connected to earth by a conductor, can, by their joint action, lift the intensest part of the field from the top of the building to the region around their summits, and so obviate or much mitigate the danger of discharge from above to the building which they cover. In illustration, diagrams are given of a vertical field of force as disturbed by vertical pillars of semi-ellipsoidal form and of various breadths, or by an earthed conducting region overhead, such as might be originated by gradual discharge from a pointed rod. —Prof. A. **Schuster**: Newcomb's method of investigating periodicities and its application to Brückner's weather cycle.—E. N. Da C. **Andrade**: The flow in metals subjected to large constant stresses. The law connecting the extension with time for wires of various metals subjected to large stresses has been examined at different temperatures. The stress was kept constant throughout the flow by the device of a hyperbolic weight employed in former experiments. The different types of flow observed for different metals at room temperature are only particular cases of one general law governing the flow of all single metals, and can all be found for one metal by choosing an appropriate temperature; thus, soft iron at 450° C. behaves similarly to lead at 15° C.—G. I. **Taylor**: Eddy motion in the atmosphere. The paper contains a theoretical discussion of the function of eddies in conveying heat and momentum through a fluid. It is shown also that measurements of the temperature of the air over the Great Bank of Newfoundland made by the author last year, lead to the conclusion that eddies extend upwards over the sea to a height of at least 800 metres; and that there is no appreciable diminution in their size or intensity at this height. On the assumption of a uniform amount of eddy motion, the velocity of the wind at various heights above the ground is calculated, and shown to agree with the most recent observations carried out over Salisbury Plain.—Prof. Ernest **Wilson**: The properties of magnetically-shielded iron as affected by temperature. In a paper recently read before the Royal Society, it is shown that if stalloy in ring form is shielded from the earth's magnetism and subjected to a considerable magnetising force at atmospheric temperature, the permeability can be increased. The present experiments deal with the effect of allowing stalloy to cool down through the temperature at which it regains magnetic quality when in a shield and when under the influence of a magnetising force due to a continuous current. Two specimens have been subjected to this treatment, and in each case the maximum permeability has a value of above 10,000 when the specimen is at atmospheric temperature.

Geological Society, April 29.—Dr. A. Smith Woodward, president; and afterwards, Mr. W. Hill, vice-president, in the chair.—A. S. **Woodward**: The lower jaw of an anthropoid ape (Dryopithecus) from the Upper Miocene of Lérida (Spain). The greater part of a mandibular ramus and symphysis of *Dryopithecus fontani* is described. The specimen is the latest jaw of an anthropoid ape hitherto discovered in Europe. The relatively small size of the first molar is to be regarded as a primitive character, lost in all modern anthropoids except some Gibbons. The shape of the mandibular symphysis is remarkably primitive, with the surface of insertion for the digastric muscle nearly as large as that of the ancestral Macaques. The anterior face of the symphysis slopes directly upwards from the front edge of this insertion, as in the Macaques, some Gibbons, and very young individuals of the chimpanzee, gorilla, and orang. It thus differs from the mandibular symphysis in adult individuals of these existing apes, in which the lower portion of the slope curves backwards into a flange or shelf of bone, while the digastric insertion is reduced in extent. So far as its lower jaw is concerned, Dryopithecus is a generalised form from which modern anthropoid apes and man have diverged in two different directions.—Prof. J. W. **Gregory**: The structure of the Carlisle-Solway Basin, and the sequence of its Permian and Triassic rocks. The Carlisle-Solway basin has been generally represented as a syncline, with the Solway resting on a great thickness of Triassic rocks. A boring made near Gretna in 1794 shows, on the contrary, that Lower Carboniferous rocks crop out there at the surface. This boring shows that the basin is not a simple syncline. The evidence derived from the boring necessitates reconsideration of the Permo-Triassic sequence in north Cumberland, as to which the Geological Survey maps and memoirs are not in agreement. Arguments are given to show that the evidence for the existence of the St. Bees Sandstone at the bottom of the Abbeytown and Bowness borings is quite inconclusive, and the fact is improbable. The view adopted by the Geological Survey map that the area west and north-west of Carlisle consists of Keuper deposits, is also improbable.

MANCHESTER.

Literary and Philosophical, April 7.—Mr. F. Nicholson, president, followed by Prof. F. E. Weiss, vice-president, in the chair.—W. C. **Grummitt** and Dr. H. G. A. **Hickling**: A preliminary note on the structure of coal. It was suggested that the essential constituent of coal is a homogeneous substance, red or orange in colour when thin enough to be transparent. This material under the microscope frequently shows evidence of "flow," and was doubtless a liquid vegetable decomposition product. This, in its purest form, constitutes the "bright" layers of coal; with strongly developed "cleat" or cleavage. Vegetable structures are preserved in coal in two forms: (1) in a "carbonised" condition, as is found pure in "mother-of-coal," and is quite opaque even when less than 1 μ thick; (2) impregnated with the transparent material described above, spores being the most readily distinguishable parts preserved in this manner. The ash from the various coals consists largely of fibrous material which is clearly an incombustible residue of vegetable structure and closely resembles the ash obtained by burning wood. The spores from certain coals can be isolated by maceration with Schultz solution.

April 28.—Mr. F. Nicholson, president, in the chair. —R. F. **Gwyther**: Specification of stress. Part v., An outline of the theory of hyper-elastic stress. The author dealt with the mathematical conditions of a body from the time of exceeding the elastic limit and when approaching to the conditions of rupture.—H. P. **Walmsley** and Dr. Walter **Makower**: The photographic action of α rays. Each α particle on striking a grain of silver in a photographic film affects that grain in such a manner as to be capable of photographic development. The path of the ray is thus apparent under the microscope.

PARIS.

Academy of Sciences, May 4.—M. P. Appell in the chair.—The **President** announced the death of M. van Tieghem, perpetual secretary.—Maurice **Hamy**: The position to be given to the astronomical observatory on Mont Blanc. Various possible sites have been examined from the points of view of uninterrupted horizon, accessibility and stability, and the advantages and disadvantages of each site discussed. The best position would appear to be the Petit Flambeau (3435 metres).—Emile **Picard**: Some reflections on certain results of Henri Poincaré concerning analytical mechanics.—Pierre **Termier**: Eduard Suess, the man and his work.—C. **Guichard**: Certain special congruences of circles and spheres.—René **Baillaud**: A photographic astrolabe.—N. E. **Nörlund**: Series of faculties. —Ernest **Esclangon**: The quasi-periodic integrals of linear differential equations.—Michel **Fekete**: A lower limit of the changes of sign of a function in an interval.—N. **Lusin**: a problem of M. Baire.—Lucien **Godeaux**: Double algebraic surfaces having a finite number of points of ramification.—Louis **Roy**: Quasi-waves in three dimensions.—L. **Dunoyer** and R. W. **Wood**: Correction to our note entitled photometry of the superficial resonance of sodium vapour under the stimulation of the D lines. A correction of an error of calculation in the determination of the width of the resonance lines.—F. **Charron**: A hydrodynamical arrangement for the magnification and registration of radio-telegraphic signals. The telephonic receiver is modified so that the vibrations are concentrated on the orifice of a vertical capillary tube. A stream of gas is flowing out of the capillary tube with a velocity just below that of turbulent flow. Sounds in the telephone produce disturbances in the flow of the gas through the jet, and these can be utilised to form a record without using a Morse receiver.—H. **Bourget**, H. **Buisson**, and Ch. **Fabry**: Interferential measurements of the radial velocities and wave-lengths in the nebula of Orion. The mean radial velocity of the nebula is +15·8 kilometres a second with respect to the sun, that is, the distance between the sun and the nebula is increasing at that rate. The wave-lengths of the characteristic double ultra-violet line had been determined and found to be 3726.100 and 3728.838. These lines are not emitted by any known element.—B. **Fessenkoff**: The law of reflection of light by matt surfaces.—J. **Minguin** and R. **Bloc**: The influence of solvents on the optical activity of the camphoric esters. The optical activity of the *allo*-acids is the same in alcoholic, benzene, or toluene solutions: the *ortho*-acids give higher rotations in benzene or toluene than in alcohol.—Marcel **Delépine**: Lithium chloro-iridate and chloro-iridite.—Jacques **Bardet**: The extraction of germanium from Vichy water. Germanium had been previously detected spectroscopically in Vichy water, and an attempt was made to isolate germanium compounds from this source. The starting point was the mixture of insoluble carbonates deposited on heating the water, and 0·06 gram of germanium oxide was prepared from 100 kilograms of deposit, representing about 250,000 litres of mineral water. The method of separation is given in detail.—M. **Vasticar**: The apparatus of support of the internal acoustic region.—Michel **Cohendy** and Eugène **Wollman**: Experiments on life without micro-organisms. Aseptic growth of guinea-pigs. These experiments prove that it is possible to raise guinea-pigs under strictly aseptic conditions, development and utilisation of food being in no way prejudiced by the absence of micro-organisms.—Louis **Cruveilhier**: Treatment of blennorrhagia by the method of sensitised virus vaccines.—Auguste **Lumière** and Jean **Chevrotier**: Some new considerations concerning the culture of gonococci.—P. **Macquaire**: The amylolytic diastase of the pancreas.—L. **Cayeux**: Eastern prolongation of the ferruginous formation of the May (Calvados) synclinal.

Cape Town.

Royal Society of South Africa, April 15.—Mr. S. S. Hough in the chair.—T. **Muir**: (1) Note on a theorem of Ph. Gilbert, regarding the differentiation of a special Jacobian. (2) Note on Rosanes's functions, resembling Jacobians.—R. T. A. **Innes**: The triple stellar system ζ Virginis and Σ 1757. These two stars, although a considerable distance apart, constitute a system as they are moving through space with almost identical velocities and directions.—G. A. H. **Bedford**: A curious mosquito.—A. L. du **Toit**: The porosity of the rocks of the Karroo system. Determinations are given of the porosity of more than ninety rocks, the majority being from borehole cores. It was found with the three-fold division of the Beaufort beds the mean porosity of the Sandstone was 2·9 per cent. for the lower, 5·2 per cent. for the middle, and 5·5 per cent. for the upper division. The figures for the Transvaal phase of the Karroo were much higher. The effects of weathering in increasing the porosity are discussed and analysed.—J. R. **Sutton**: A note on the temperatures of the air observed at Mochudi. The note gives a brief account of some points of interest in the results of temperature observations by Harbor at Mochudi in the Bechuanaland Protectorate. The extremes of temperature are considerable, the greatest range so far observed being from 108° F. to 28° F. The mean maximum temperatures depend upon the sun's meridian altitude in much the same way as they do at Kimberley. The annual cold wave of the middle of July is felt at Mochudi like it is elsewhere further south.

BOOKS RECEIVED.

The Simpler Natural Bases. By Prof. G. Barger. Pp. viii+215. (London: Longmans and Co.) 6*s*. net.

Department of Marine and Fisheries. Report of the Meteorological Service of Canada, Central Office, Toronto, for the Year ended December 31, 1910. Vol. i. Introduction and Parts i.–iii. Pp. xxiii+341. Vol. ii. Parts iv–vi. and Appendix. Pp. 342–604. (Ottawa: C. H. Parmelee.)

The Therapeutic Value of the Potato. By H. C. Howard. Pp. 31. (London: Baillière and Co.) 1*s*. net.

Ernährungsphysiologisches Praktikum der höheren Pflanzen. By Prof. V. Grafe. Pp. x+494. (Berlin: P. Parey.) 17 marks.

American Mathematical Society. Colloquium Lectures. Vol. iv. The Madison Colloquium, 1913. i., On Invariants and the Theory of Numbers. By L. E. Dickson. ii., Topics in the Theory of Functions of Several Complex Variables. By W. F. Osgood. Pp. vi+230. (New York: American Mathematical Society.)

Smithsonian Institution. Bureau of American Ethnology. Bulletin 56. Ethnozoology of the Tewa Indians. By J. Henderson and J. P. Harrington. Pp. x+76. (Washington: Government Printing Office.)

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere. Edited by Prof. A. Oppel. Achter Teil. Pp. x+168. (Jena: G. Fischer). 8 marks.

The British Academy. Palissy, Bacon, and the Revival of Natural Science. By Sir T. Clifford Allbutt. Pp. 15. (London: Oxford University Press.) 1*s*. net.

Bulletin of the Illinois State Laboratory of Natural History, Urbana, Ill., U.S.A. Vol. x., Article 3: Studies on the Enchytrœidœ of North America. By Dr. P. S. Welch. Pp. 212+Plates viii–xii. (Urbana, Ill.)

British Museum (Natural History). A Monograph of the Genus Sabicea. By H. F. Wernham. Pp. v+82+xii Plates. (London: British Museum.) 6*s*.

A Revision of the Ichneumonidæ. Based on the Collection in the British Museum (Natural History). Part iii. By C. Morley. Pp. xi+148. (London: British Museum.) 5*s*. 6*d*.

British Museum (Natural History). Report on Cetacea stranded on the British Coasts during 1913. By Dr. S. F. Harmer. Pp. 12. (London: British Museum.) 1*s*. 6*d*.

Elements of Algebra. By G. St. L. Carson and Prof. D. E. Smith. Part i. Pp. v+346. (London: Ginn and Co.) 3*s*.

Journal of the British Fire Prevention Committee. No. ix. (Special subject.) Table G. The Fire Resistance of Partitions. Pp. 8+1 Table. (London: The British Fire Prevention Committee.) 10*s*. 6*d*.

Annuaire Général de Madagascar et Dépendances, 1914. Pp. x+745. (Tananarive.)

X-Rays: an Introduction to the Study of Röntgen Rays. By Dr. G. W. C. Kaye. Pp. x+252. (London: Longmans and Co.) 5s. net.

I Minerali. By Prof. E. Artini. Pp. xv+422+40 Plates. (Milano: U. Hoepli.) 9.50 lire.

Beiträge zur Kenntnis der Land- und Süsswasserfauna Deutsch-Südwestafrikas. Edited by W. Michaelsen. Lief. i. Pp. 182+4 Plates. (Hamburg: L. Friederichsen and Co.) 12 marks.

Beiträge zur Kenntnis der Meeresfauna Westafrikas. Edited by W. Michaelsen. Lief i. Pp. 84+2 Plates. (Hamburg: L. Friederichsen and Co.) 6 marks.

Lectures Introductory to the Theory of Functions of Two Complex Variables. By Prof. A. R. Forsyth. Pp. xvi+281. (Cambridge: University Press.) 10s. net.

Kinetische Stereochemie der Kohlenstoffverbindungen. By Dr. A. von Weinberg. Pp. viii+107. (Braunschweig: F. Vieweg und Sohn.) 3 marks.

Canada. Department of Mines. Memoir No. 18 E. Bathurst District, New Brunswick. By G. A. Young. Pp. 96+9+Maps. Memoir No. 26. Geology and Mineral Deposits of the Tulameen District, B.C. By C. Camsell. Pp. vii+188+10+maps. (Ottawa.)

Photography in Colours. By Dr. G. L. Johnson. Second (Revised) Edition. Pp. xiv+243+13 Plates. (London: G. Routledge and Sons, Ltd.) 3s. 6d. net.

Common British Beetles. By Rev. C. A. Hall. Pp. viii+88+16 Plates. (London: A. and C. Black.) 1s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 14.

ROYAL SOCIETY, at 4.30.—The Various Inclinations of the Electrical Axis of the Human Heart. IA.: The Normal Heart. Effects of Respiration: Dr. A. D. Waller.—Fossil Plants showing Structure from the Base of the Waverley Shale of Kentucky: Dr. D. H. Scott and Prof. E. C. Jeffrey.—The Controlling Influence of Carbon Dioxide in the Maturation, Dormancy, and Germination of Seeds. II.: F. Kidd.—The Cultivation of Human Tumour Tissue *in vitro*: D. Thomson and J. G. Thomson.—The Nutritive Conditions Determining the Growth of Certain Freshwater and Soil Protista: H. G. Thornton and G. Smith.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

CONCRETE INSTITUTE, at 7.30.—Sand and Coarse Material and Proportioning Concrete: J. A. Davenport and Prof. S. W. Perrott.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Notes on the Chemistry of Starch and its Transformations: W. A. Davis.—The Analysis of Malt Extracts: W. P. Dreaper.—Temperature and Concentration as Affecting Hydration and Soda Absorption during the Process of Formation of Cellulose Monofils: Clayton Beadle and H. P. Stevens.

FRIDAY, MAY 15.

ROYAL INSTITUTION, at 9.—Plant Animals: A Study in Symbiosis: Prof. F. Keeble.

SATURDAY, MAY 16.

ROYAL INSTITUTION, at 3.—Bird Migration: Prof. C. J. Patten.

MONDAY, MAY 18.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Static Transformers, the Design and Application: F. R. Peters.

VICTORIA INSTITUTE, at 4.30.—The Composite of Races and Religions in America: Rev. Dr. S. B. McCormick.

TUESDAY, MAY 19.

ROYAL INSTITUTION, at 3.—Natural History in the Classics. I.: The Natural History of the Poets, Homer, Virgil, and Aristophanes: Prof. D'Arcy W. Thompson, C.B.

ROYAL STATISTICAL SOCIETY, at 5.—Suggestions for Recording the Life History and Family Connections of Every Individual: W. Hazell.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on the Circulatory System of Elasmobranchs, I.: The Venous System of the Dogfish (*Scyllium canicula*): Dr. C. H. O'Donoghue.—Scent-organs in Trichoptera: B. F. Cummings.—Notes on Plumage Development in the African Wood-stork: G. Jennison.—A New Cestode from an Albatross (*Diomedea irrorata*): H. A. Baylis.—The Deinocephalia, an Order of Mammal-like Reptiles: D. M. S. Watson.—The Species of the Genus Paralastor, Sauss, and some other Hymenoptera of the Family Eumenidæ: Dr. R. C. L. Perkins.

ROYAL SOCIETY OF ARTS, at 4.30.—The Singing of Songs: Old and New. II.: Classical Songs: H. Plunkett Greene.

WEDNESDAY, MAY 20.

AERONAUTICAL SOCIETY, at 8.30.—Wilbur Wright Memorial Lecture: Dr. R. T. Glazebrook.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Reduction of Barometer Readings in Absolute Units, and a New Form of Barometer Card: E. Gold.—A Cuban Rain Record and its Application: A. Hampton Brown.

ROYAL SOCIETY OF ARTS, at 8.30.—The Channel Tunnel and its Early History: J. C. Hawkshaw.

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

THURSDAY, MAY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Effect of the Magneton in the Scattering of α Rays: Prof. W. M. Hicks.—Luminous Vapours Distilled from the Arc, with Applications to the Study of Spectrum Series and their Origin. I.: Hon. R. J. Strutt.—The Ionisation of Gases by Collision and the Ionising Potential for Positive Ions and Negative Corpuscles: W. T. Pawlow.—The Determination of Elastic Limits under Alternating Stress Conditions: C. E. Stromeyer.—The Emission of Electricity from Various Substances at High Temperatures: G. W. C. Kaye and W. F. Higgins.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Gulf Stream: Commander Campbell Hepworth.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Census of 1911: Ethnography and Occupations: E. A. Gait.

FRIDAY, MAY 22.

ROYAL INSTITUTION, at 9.—The Mortuary Chapels of the Theban Nobles: R. Mond.

PHYSICAL SOCIETY, at 5.—Volatility of Thorium Active Deposit: T. Barratt and A. B. Wood.—The Passage of α-Particles through Photographic Films: H. P. Walmsley and Dr. W. Makower.—A Null Method of Testing Vibration Galvanometers: S. Butterworth.—Experiments with an Incandescent Lamp: C. W. S. Crawley and S. W. J. Smith.

SATURDAY, MAY 23.

ROYAL INSTITUTION, at 3.—Fiords and their Origin. I.: The Nature and Distribution of Fiords: Prof. J. W. Gregory.

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THURSDAY, MAY 21, 1914.

CHEMISTRY: ANCIENT AND MODERN.

Some Fundamental Problems in Chemistry—Old and New. By Prof. E. A. Letts. Pp. xiii + 235 + plates. (London: Constable and Co., Ltd.) Price 7*s.* 6*d.* net.

THOSE chemists whose memories can carry them back for a period of about half a century will have experienced several phases in the development of the science which, at their respective periods, were regarded as marking a transition from an older to a newer chemistry. The writer of this notice began his reading when water was HO and so forth. Then came the "new notation" resulting from the proper recognition of Avogadro's law, the doubling of certain atomic weights, and the reconstruction of our formulæ. This was the "new chemistry" of that period. Next arose the more complete elaboration of the conception of constitution or structure based on valency, due to Frankland and Kekulé, and we had a yet newer chemistry—a development which was so extraordinarily prolific in the way of results that chemists were inclined to hug themselves into the belief that they had come to close quarters with the inner mechanism of molecular structure, and the very weaknesses of the theory, which had shown signs of breaking down in certain directions, afterwards became cornerstones of strength in the light of the brilliant hypothesis of van't Hoff and Le Bel, which inaugurated the then new science of stereochemistry. Moreover, about the same period when structural chemistry was undergoing these developments, attention was being more systematically concentrated upon the relationships of the chemical elements among themselves, these studies culminating in that periodic classification associated with the names of Newlands, Mendeléeff, and Lothar Meyer. From that great generalisation arose a still newer chemistry which systematised the whole treatment of the science, both theoretically and practically, and dominates our present teaching. Another "new" chemistry must be added to this record—the application of purely physical methods to the study of chemical phenomena resulting in the foundation of "physical chemistry" as a distinct subject.

All these phases are familiar to the modern student of the history of the science, and they fall into the category of what the author of the present work would term the older chemistry. Dr. Letts does not, however, deal with all these developmental epochs; the older chemistry—as distinguished from ancient chemistry—is limited by him to the discussion of the methods and results of atomic weight determinations by the older as well as by the most recent workers in this field, and to a very full consideration of the periodic law and its consequences. The reader will find no reference to those fundamental problems relating to chemical statics and dynamics which the physical chemists have formulated as the results of their studies; such familiar terms as mass action, osmotic pressure, electrolytic or ionic dissociation, stereochemistry, etc., do not appear in the index. This criticism amounts simply to the statement that the author professes to deal only with certain of the fundamental problems, and within the limits thus assigned, he handles his subject in a very lucid and suggestive way. His treatment of the periodic law, for example, to which two chapters are devoted, goes far beyond the arid description found in the ordinary textbooks and may be commended as worthy of most serious consideration by all students. Workers on the look-out for new elements may take courage from Dr. Letts's suggested classifications, according to which there remain either thirty-eight or twenty-five gaps in the periodic table now waiting to be filled up (p. 60). Another valuable feature of this section is the new "atomic volume" curve, constructed by the author from the most recent available data, and, for the first time, comprising the group of "inert" elements. As will be seen on reference to the original work, this curve differs in some important particulars from that first given to our science by Lothar Meyer in 1870, and opens up some interesting suggestions with respect to missing elements.

Although the older chemistry is treated of in the present work within the limits specified, the reader will gather from the subsequent chapters that these older workers—and happily for our science that generation has not yet become extinct—have passed on to the newer school a very goodly heritage. By the "newer chemistry" Dr. Letts understands that great body of observed facts and theoretical deductions which have been accumulated since the study of the action of the electric discharge upon highly attenuated, gaseous matter was seriously taken in hand by physicists and chemists, and since the discovery of radioactivity and the radio-active elements. How much of this newer knowledge will be passed on as canonical to future generations it would be very rash to predict. It is, however, certain that chemistry, by the discovery of unexpected phenomena, and by the utilisation of novel methods of attacking the ultimate components of matter, has now entered upon a new era in its history—a state of affairs which both students and teachers, whether of the older or newer school, must perforce take into consideration.

From this last point of view the present work presents certain special advantages which may be summed up by the statement that the author handles his subject as a chemist. The day has passed away when workers with parochial views of their science can hope to impose upon the present generation stupidly narrow limitations by "method"—to insist that the evidence based upon "purely chemical" methods is alone of weight to chemists, and that the results achieved by "purely physical" methods must be received with suspicion. But for the chemist it certainly is of importance, in view of the bewildering rapidity of the development in this newer domain, to have the results, by whatever method achieved, co-ordinated and fitted in to that older structure with which we were all familiar in the days of our own studentship. Dr. Letts may be congratulated upon having accomplished this task with conspicuous success within the compass of his brief. His historical records, which are fairly given, are as up-to-date as can reasonably be expected, and the descriptive portions are summarised at the end of the chapters with a clearness which shows that the author has a thorough grasp of his subject. Perhaps it may be urged by extreme critics that he is not sufficiently critical—that he appears to accept as established truths and without comment published statements concerning "transmutation," about which there is conflict of evidence. But the present work professes to be but a literary production, and the author, perhaps wisely in the present state of knowledge, simply sets forth the evidence and the suggested interpretations of that evidence. All who have watched the development of this "newer chemistry" have thoroughly realised the extraordinary practical difficulties which confront the experimenter at every stage. The infinitesimal quantities of material which have to be dealt with and the extreme delicacy of the methods of attacking the new problems offered by a subject which is still "in the making" are such as to give much scope for apparently conflicting evidence. The future writer of the history of chemistry will find ample matter for marvel at the results which have even now been achieved in spite of the difficulties referred to. That Dr. Letts is himself appreciative of the skill which has surmounted so many of these obstacles is apparent in many pages of the volume under consideration.

It is now a matter of ancient history that on the discovery of spectrum analysis chemistry and astronomy entered into partnership. But the new chemistry, as understood in the present work, has also widened the horizon of the science to an extent that renders necessary the consideration by chemists of problems of a cosmical order in a much more definite and concrete form than has hitherto been customary. It is obvious that questions concerning the constitution of the atom and the evolution or disintegration of matter cannot be confined within terrestrial limits. On the first of these questions the author has something to say, and in the ninth chapter will be found a succinct account of the electron theory, with reference more especially to the work of J. J. Thomson. Now it is precisely on this question of the present position of the electron theory that chemists are awaiting further light from the physical side. So far, with the exception of Sir William Ramsay's preliminary attempt, this theory cannot be said to have been brought seriously within the domain of practical chemical politics. It is not mere curiosity that prompts the chemist to ask whether the atom is to be regarded as a complex mechanism composed entirely of electrons or whether there may not be other components. Dr. Letts thus answers the question:—

"From spectroscopic and other evidence it would appear to be certain that electrons are universal constituents of atoms, but on the other hand, there appears to be no sufficient evidence for the assumption that electrons are the sole constituents of these atoms. . . . all but about one-thousandth of its mass is associated with the positive part of an atom, which would tend to show that an altogether exaggerated rôle has been attached to the electron in the constitution of matter."

This at any rate was the view held by the writer of the section on radioactivity in the Annual Reports of the Chemical Society in 1906, from whom the author takes his information.

With reference to the other question—the evolution and dissolution of matter—the reader will find in the tenth chapter a good summary of the observations and conclusions of Lockyer, as set forth in his "Inorganic Evolution" and other publications. One result of the "new chemistry" is thus to bring us back to what may be termed the presentation of the case from the astrophysical side. There is distinct evidence of this reactionary influence of the new chemistry upon the pioneering work of Lockyer now to be found in many recent treatises besides the volume under consideration, in which some twenty pages are devoted to the subject. The "disintegration" theory of radio-activity, which now holds the field, has brought into modern chemistry certain very concrete notions concerning what may be defined as down-grade evolution. It is but natural to ask with Dr. Letts (p. 190) whether the reverse or up-grade process of evolution from elements of low atomic weight to elements of higher atomic weight occurs anywhere in the cosmos. If evolution is universally true in principle some process of this order must have occurred in the past and may be occurring now. Laboratory results which are indicative of "transmutation" in the sense of degradation are becoming more and more incorporated with modern chemical doctrine, but experimental evidence of the opposite process can scarcely be considered at present conclusive. The notion of utilising the energy of degradation of radium emanation for transmutational purposes was presumably based on the expectation of degradation rather than of aggregation.

The question of the evolution of the chemical elements is an old one, and the suggestion of evolution offered by the periodic law has been taken up by many writers whose speculations are no doubt familiar to chemists. The author of the present work does not discuss any of these speculative attempts to trace the lines of descent, although he gives some very useful tables summarising existing knowledge with respect to the disintegration products of the radio-active elements. But in directing attention once again to the evidence of evolution furnished by the study of stellar spectra by that comparative method which will always be recognised as the work of Lockyer and his school, Prof. Letts does good service by reminding chemists that the newer developments of their science have enhanced the importance of astrophysical (why not astrochemical?) work to an extent quite undreamt of at the time when the spectroscope was first brought to bear upon these problems.

If any justification for undertaking the part of a critic is required on the present occasion it may be permissible to express regret that the author should have devoted so much space to reprinting long extracts from the original writings of the authorities quoted. All the books and papers referred to are easily accessible, and Dr. Letts gives evidence of being such a very clear thinker when he deals with his subject in his own way that we should much have preferred to read his own version and criticisms. This particularly applies to the last chapter, which is devoted to an account of the views of Arrhenius in his now well-known book on "Worlds in the Making" published in 1908. The direct bearing of the views set forth in that work on the fundamental problems of modern chemistry are not very obvious, and we should have been glad if Dr. Letts could have given less space to the extracts from the said book and more space to the discussion of the special reasons for including the subject in his own volume. The main contribution to purely "astrochemical" thought which must be credited to Arrhenius would appear to be the recognition of heat as an associative as well as a dissociative agency. In theories of cosmical evolution, this point may have been insufficiently realised, although the possibility of endothermic combination between certain elements under high pressure in the sun and stars cannot be generalised into a universal process for all kinds of matter without further evidence.

Enough has been said, however, to warrant the statement that the author has produced a most useful and suggestive little volume which may be profitably read by chemists of both the older and younger generations.

R. MELDOLA.

GEOLOGY AND GEOGRAPHY.

(1) *La Face de la Terre.* (Das Antlitz der Erde.) By Prof. Ed. Suess. Traduit de l'Allemand avec l'Autorisation de l'Auteur et Annoté sous la Direction de Emm. de Margerie. Tome 3. (3 Partie.) Pp. xi+957—1360. (Paris: Armand Colin, 1913.) Price 12 francs.

(2) *Traité de Géographie Physique. Climat—Hydrographie—Relief du Sol—Biogéographie.* By Prof. Emm. de Martonne. Deuxième Edition. Pp. xii+922. (Paris: Armand Colin, 1913.) Price 22 francs.

THE two volumes before us strikingly illustrate the principle that scientific geography —as distinct from mere geographical description —must be based on the deductions of geology and the physical sciences; and no less do they indicate how much geology looks to gain from the study of the present features of the earth's surface, and of terrestrial processes now going on upon it.

(1) That M. Margerie's French edition of the great work of the distinguished Austrian geologist is not a mere translation has been already pointed out in the pages of NATURE. The judicious notes, bringing the text up-to-date, with the exhaustive references to recent literature and the numerous additional illustrations, make the book an absolute necessity in every scientific library. In this third part of vol. iii., M. Margerie has reached the penultimate section of his great task, and an additional coloured plate, with eighty new illustrations in the text, give a measure of the important additions which have been made to the original work.

(2) Nor are the additions which have become necessary to the comprehensive volume of Prof. de Martonne less abundant and important. Since the first edition appeared four years ago, the author reminds us that geographical research has added largely to our knowledge—not the least striking

additions being the visits paid for the first time to both the poles within that period! No fewer than 216 pages, with four plates and fifty figures in the text, have been added to the book to bring it thoroughly up-to-date. The present edition maintains the character of the original one, as an invaluable work of reference upon the subjects of which it treats. J. W. J.

WORKS ON ECONOMICS.

(1) *The Influence of the Gold Supply on Prices and Profits.* By Sir David Barbour. Pp. xii+104. (London: Macmillan and Co., Ltd., 1913). Price 3s. 6d. net.

(2) *Social Insurance. With Special Reference to American Conditions.* By I. M. Rubinow. Pp. vii+525. (New York: Henry Holt and Co., 1913.) Price 3.00 dollars net.

(1) SIR DAVID BARBOUR'S long experience in connection with the finances of India gives great weight to his conclusions on questions of currency and of the standard of value, in which he holds a position of authority. In the present work he undertakes to show in what way the quantity of money affects prices, and what are the limitations to the theory that its influence upon them is substantial. This is a question of real importance, because variations in price exercise a "profound and subtle influence" on human affairs. "A general fall in prices sets up stresses in the social fabric which search out the weak points in the structure. A general rise in prices smooths away many difficulties, but may create others." The author puts his theory in the form that "other things being equal, the level of prices is proportionate to the quantity of money." The question arises, What are the "other things" that are required to be equal, in order that this generalisation may be supported? It is important to consider the modern system of credit, as affecting the amount and efficiency of the work money has to do. Sir D. Barbour rightly deprecates the dangerous practice, which apears to be growing, of attempting to remedy by legislation the evils that are due to a rise or fall in prices.

(2) Mr. Rubinow's work is an elaborate study of a subject which has of late years acquired great importance in England and other European countries, and an urgent plea for general adoption of a policy of social insurance in the United States of America. The expression "social insurance" is, indeed, one of comparatively recent introduction, and is used as distinctive from commercial insurance, though there is no real difference of principle between them. The difference in practice arises when voluntary insurance develops into subsidised insurance, and that again into compulsory insurance. Under these heads the author describes what has been done in Europe towards insurance against industrial accidents, against sickness, against old age, invalidity and death, and against unemployment; and necessarily devotes much attention to the history of the movement in those directions in Germany and in England. In neither country does he consider that all the branches of social insurance have been adequately developed. All leave unrelieved many exceptional cases. The relief is, in general, insufficient. The question of cost becomes a material one if this is to be remedied. Here, we think, Mr. Rubinow takes too optimistic a view. He estimates the burden of the British insurance system as between 85 and 100 million dollars, and compares it with the 160 million dollars that the United States have been (we fear, improvidently) spending for war pensions. Estimating that the wealth of that country increases annually by 5000 million dollars, after all truly wasteful expenditures, both private and public, have been allowed for, he thinks it unnecessary to discuss whether it can afford the expense of a social insurance system.

Both these works are valuable contributions to the study of economics.

OUR BOOKSHELF.

The Riddle of Mars the Planet. By C. E. Housden. Pp. xi+69+plates. (London: Longmans, Green and Co., 1914.) Price 3s. 6d. net.

THERE are many who have read with real pleasure Dr. Percival Lowell's pleasant diversions based upon his assiduous and careful observations of the planet Mars, which the magnificent equipment of his well-placed observatory have made possible. Whether they have followed him to all his conclusions is immaterial, they have admired his skill and industry, his beautiful photographs, his imagination and the charming way in which he has presented his case. Among his followers the author of the present work is one who is not content with merely following Dr. Lowell, but, being apparently of a constructive turn of mind, he has gone in considerable detail into the engineering works that are obviously required to help the water of the melting snow caps to the parts of the planet where it is wanted for the growing crops. By the use of a coloured plate or diagram on which the colour changes in different latitudes in the course of the Martian year are represented, the author develops the engineering problem of moving the water, using open canals or closed pipes where water is pumped over or to high ground. He wants for this purpose 2,500,000,000 N.H.P.; 170,000 6-ft. pipes, each 1400 miles long, with ten pumping stations of 1150 N.H.P. to each to account for part of the total power required. Oil engines are suggested, the oil being obtained from wells as on earth, but possibly sun power in the clear sky is used as in Egypt. The author goes into details in other directions which it seems unnecessary to follow, and he estimates the area requiring irrigation and producing crops twice a year by a consideration of the colour changes.

The Mechanical Engineer's Reference Book. By H. H. Suplee. Fourth edition, revised and enlarged. Pp. xii+964. (London and Philadelphia: J. B. Lippincott Company, n.d.) Price 18*s*. net.

THE first edition of this well-known book was published in 1903. Sections are included giving mathematical formulæ and tables, information on mechanics, materials, machine design, heat, air, water, fuels, steam boilers and engines, internal combustion motors, and electric power. While much of the information supplied is good, and renders the book of service to engineers, there is a considerable amount of space taken up with matter which is surely unnecessary in an engineering reference book. Some of the very elementary geometry given on p. 107 *et seq.* might be eliminated. There are few engineers who would require to consult a reference book in order to find out how to bisect a line by another line at right angles. The tables given on pp. 432 and 433 face one another, but the book has to be inverted before the second table can be read. On p. 274 there is a table giving the heights traversed by a falling body to seven significant figures. The American nomenclature in several places makes it somewhat difficult to obtain the precise meaning.

The real test of the value of an engineering reference book is the up-to-dateness of its contents, otherwise the book will be used probably for the sake of the tables of areas and circumferences of circles, logarithms, etc. The present edition is by no means up-to-date in several of its sections; those dealing with the strength and elasticity of materials and the properties of steam may be specially mentioned in this respect, where very little mention is made of the valuable developments which have taken place during the last ten years.

Outlines of Chordate Development. By Prof. W. E. Kellicott. Pp. v+471. (New York: H. Holt and Co., 1913.) Price 2.50 dollars.

PROF. W. E. KELLICOTT'S introduction to the study of chordate development begins with Amphioxus, which "affords in simple diagrammatic style, the essentials of early chordate ontogeny"; it lingers over the frog; it treats the chick more briefly, but lays emphasis on the embryonic membranes and the early stages; it ends up with the mammal, with particular reference to the early stages, the fœtal membranes and the placenta, and the development of the external form. The book is well arranged, carefully and clearly written, and effectively illustrated. We think that it might have been made more interesting and distinctive by being more definitely correlated with phylogeny and comparative anatomy; but that, of course, is a big business. The well-selected bibliographies point the way.

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.*]

Action of Radium Rays on Bakelite.

A DISC 4·2 mm. thick of the light yellow variety of transparent Bakelite was cut from a rod, polished and radiated with β and γ rays from radium. The colour of the disc darkened to a wine-red after three days, and exhibited an absorption band $\lambda=5700-6000$, which was not visible at first. The spectrum beyond $\lambda=4900$ Å.U. was also obliterated. A similar disc placed in radium emanation became also rapidly coloured. The coloration extended to a depth of 2 mm., and it could be completely removed by exposure to a temperature of 100° C. for about three hours.

In order to see whether ozone played any part in the action a Bakelite disc was exposed to the gas for six hours both alone and with radium near. Not the slightest coloration occurred. A portion of a rod was coated with paraffin wax and the radium rays caused to radiate the rod partly through the wax layer. There was no diminution in the rate of colouring under the wax. The effect, therefore, appears to be due to the direct action of β rays upon the Bakelite, for it would extend much deeper were it due to the γ rays. This new substance may prove to be a useful filter for therapeutic use, especially as it is cleanly and easy to work.

CHARLES E. S. PHILLIPS.

Physics Laboratory, Cancer Hospital,
May 14.

Respiratory Movements of Insects.

THE concertina-like movement observable in the abdomen in the case of wasps and bees is, I believe, the visible evidence of the act of pumping the air in and out for respiratory purposes, and a similar phenomenon may be seen in dragon-flies, except that in the latter the movement is lateral and slow, whilst in wasps and bees it is axial and rather quick. I have not noticed any such movement in other groups of the Hymenoptera, and it is apparently absent in the Diptera, except *Eristalis tenax*, the common drone-fly, which obviously mimics the hive bee and other small species. If this movement really is due to respiration can any reader say why it is so comparatively restricted in the insect world? One would have expected soft-bodied insects, such as Diptera, to exhibit it more obviously than the more chitinous species amongst the Hymenoptera. I, and probably others, should be glad of any information throwing light on this matter.

C. NICHOLSON.

MR. NICHOLSON has hit upon an interesting inquiry, and will probably not be surprised to find that it has already received a good deal of attention. The respiratory movements of insects were experimentally investigated by the late Prof. Felix Plateau, of Ghent ("Recherches Expérimentales sur les Mouvements Respiratoires des Insectes," *Mém. Acad. Roy. de Belgique*, tome xlv., 1884), who contributed a short summary of his results to Miall and Denny's "Cockroach" (pp. 159–64). Respiratory movements can be demonstrated in dipterous flies, but in them the enlarged thorax is alternately contracted in different directions by the action of two sets of muscles, which are figured in Miall and Hammond's "Harlequin Fly," (pp 100–102). Far more space than NATURE could grant would be required to discuss the mechanism of respiration in different insects. I do not recollect that any notable progress has been made with the inquiry during the last thirty years, and a new observer would find that much remains to be discovered; it is, however, indispensable that he should employ precise methods of investigation. L. C. M.

THE NUMBER AND LIGHT OF THE STARS.

THE number of stars visible to the naked eye on a clear night, in the whole sky, is roughly 5,000—a very moderate total indeed, in spite of the universal custom of using the number of the stars, in common with that of the sands of the sea, as synonymous with infinity. In all ages mankind in general has rightly preferred rather to admire and wonder at the stars than to count them. In the great problem of the structure of the sidereal universe, however, which astronomers are now attacking with much energy and success, one of the essential data is the number of stars in the different regions of the sky, classified according to their brightness or magnitude.

The telescope early revealed the fact that the stars which by reason of their superior brightness force themselves upon our unaided vision shine forth beyond a host of fainter luminaries, the number of which has never yet failed to show an increase as an augmentation of telescopic or photographic power has enabled us to pierce depths of greater and greater obscurity. These fainter stars enormously outnumber the naked-eye stars, which may be compared with an oceanic island, the tiny, outstanding peak of a great mountain growing ever broader beneath the water level.

The bright stars have been divided into six traditional classes or magnitudes, the brightest being called first magnitude stars, and the faintest visible being termed of the sixth magnitude. Pogson placed this classification on a scientific basis, so that it could be extended to telescopic stars of all degrees of faintness. On the conventional standard scale the ratio of the intensities of two stars differing in magnitude by the amount m is $10^{-0 \cdot 4 m}$. The determination of the magnitude of a star on this scale is not an easy matter, as it involves the measurement of the relative brightness of stars often differing much in luminosity.

Photographic methods have been found most suitable for the purpose; the results are rather different from those obtained by visual methods, especially for stars of different colour, since the photographic plate is more sensitive than the eye to blue rays, and less sensitive to red. Magnitudes determined by ordinary photographic methods are called "photographic magnitudes."

During the past three years the fine series of star charts obtained by the late J. Franklin-Adams has been used in the investigation of the number of stars of determined photographic magnitudes in all parts of the sky. Franklin-Adams, using a specially-designed Taylor-Cooke 10-in. lens covering a wide field, photographed the whole sky on 206 plates each 16 in. square, the scale being 20 mm. to 1°; the photographs were taken (the northern set in England, the southern in South Africa) with exposures of from two to two and a half hours, which sufficed to show stars down to the seventeenth magnitude on most of the plates. From a star of this magnitude we receive only one-millionth as much light as from a second magnitude star. On each plate the stars in twenty-five uniformly distributed sample areas have been counted and classified according to the size and greyness of their images; altogether, therefore, sample counts have been made on more than 5000 regions of the sky, at intervals of 3° apart. The areas examined were of different sizes, being chosen, in accordance with the star density in the particular region, so that about sixty stars should be counted in each. The stars could not be classified according to their photographic magnitude directly from the plates, as stars of different magnitudes might show images, identical in size and greyness, on different plates, owing to inequality of the atmospheric transparency during the exposures on the two plates. The photographic magnitudes of a selection of the stars counted on each plate needed, therefore, to be determined directly, which was done by comparing them with the stars of the North Polar Sequence, a set of stars the magnitudes of which have been given very accurately by Prof. E. C. Pickering of Harvard. Auxiliary photographs for this purpose were taken with the 30-in. reflector at Greenwich. After the application of corrections depending on their position on the Franklin-Adams plates it was then possible to classify all the stars counted, upon a true magnitude basis. This complete reduction has so far been effected for thirty out of the 206 plates counted; the results from the 750 areas for which sample counts were thus afforded have recently been published.[1]

The first point of importance which will be mentioned as one on which the evidence derived from this work is decisive is that of the relation between the condensation of the stars towards the galaxy, and their magnitude. While the very brightest stars show little regularity of distribution (to their irregular grouping, indeed, much of the beauty of the constellations is due), the fainter naked-eye stars show a distinct concentration towards the plane of the Milky Way, their density in the galactic belt of the celestial sphere being about twice that near the poles of the Milky Way; still fainter stars down to the ninth magnitude show this phenomenon in a more marked degree, the density of these stars in the galaxy being three or four times that at the galactic pole. The galactic plane is a fundamental one in modern representations of the sidereal universe, which, following Sir W. Herschel's ideas, picture the stellar system as formed of a large central cluster

[1] Chapman and Melotte: The number of stars of each photographic magnitude down to 17·0m., in different galactic latitudes. Memoirs of the R.A.S., lx., 4.

Chapman: On the total light of the stars. Monthly Notices of the R.A.S., lxxiv.

of stars in the form of an oblate spheroid, equatorially surrounded by a belt of irregular star-clouds composing the Milky Way. In connection with such a theory it is of obvious importance to know whether the condensation towards the galaxy shown by the stars of magnitudes five to nine persists for still fainter stars, and in what degree. Very different views have been held on this matter. In regard to the stars classified according to their visual magnitudes, Kapteyn concluded that the galactic condensation increases very much with diminishing brightness, giving its value for all the stars brighter than 17^m as 45. Pickering, on the contrary, found no marked change in the relative densities in the galaxy and at its poles, down to the thirteenth magnitude (the limit of his data). The counts on the Franklin-Adams plates, based on a photographic magnitude classification, lead to a similar result; the density of all the stars brighter than 17^m in the galaxy does not exceed six times that at the galactic poles, and the ratio is perhaps not more than four. Although it is possible that there may be a systematic change of colour of the stars with increasing faintness, different in different galactic latitudes, which would make results derived from counts of stars of determined *visual* magnitudes differ systematically from those based on photographic magnitudes, yet such evidence upon the point as already exists renders it probable that the galactic condensation is in either case nearly constant from the sixth to the seventeenth magnitude.

On this account the rate of increase in the number of stars per magnitude will be nearly constant all over the sky, so that this rate may conveniently be studied from a table giving the numbers of stars in the whole sky brighter than each magnitude m; this will be denoted by N_m. All the best available data have been embodied in the following table, giving N_m for values of m down to 17. The values of $\Delta_m (= \log N_{m+1}/N_m)$ are also given, as they provide a measure of the geometric ratio of increase in the number of the stars.

TABLE I.—*The Number of Stars in the Whole Sky Brighter than Magnitude m.*

m	N_m	$\log N_m$	Δ_m
2	38	1·58	
3	111	2·05	0·47
4	300	2·48	0·43
5	950	2·98	0·50
6	3,150	3·50	0·52
7	9,810	3·99	0·49
8	32,360	4·51	0·52
9	97,400	4·99	0·48
10	271,800	5·43	0·44
11	698,000	5·84	0·41
12	1,659,000	6·22	0·38
13	3,682,000	6·57	0·35
14	7,646,000	6·88	0·31
15	15,470,000	7·19	0·31
16	29,510,000	7·47	0·28
17	54,900,000	7·74	0·27

The data for the stars of magnitudes 2 to 6 are somewhat uncertain, which accounts for the irregular run of the first few values of Δ_m, but beyond this point the steady decrease in Δ_m is very noticeable. This clearly shows that modern photographic telescopes now penetrate to regions of space where the stars begin to thin out in numbers to a quite considerable extent, for it is easy to prove that if the stars were distributed uniformly throughout space, Δ_m should preserve the constant value 0·6. This assumes, what appears to be fairly correct, that any possible absorption of light in space does not materially diminish Δ_m.

From the numbers in the foregoing table, the following simple rational formula can be derived,

$$\log \frac{dN_m}{dm} = a + bm - cm^2,$$

or, in an equivalent form,

$$N_m = A \frac{1}{\sqrt{\pi}} \int_{-\infty}^{B(m-C)} e^{-x^2} dx.$$

The latter formula, which is the integral of the error curve, implies that the total number of the stars is finite, and this is now generally accepted as true; A represents this total number, while C denotes the magnitude which divides all the stars into two equal groups, those brighter being equal in number to those fainter. A, B, C can be deduced from a, b, c, which are readily obtained from the observed values of N_m, but A is not narrowly determined—its value seems to be not less than 1000 million, and probably not greater than 2000 million, so that the total number of the stars is comparable with the population of the earth (this is roughly estimated as 1600 million). The constant C is more closely determined, and is approximately 23 or 24. Stars of this magnitude could just be photographed, with many hours exposure, with the largest telescope in the world, the 60-in. reflector at the Mount Wilson observatory. There remain, therefore, beyond our present powers of exploration still fainter stars equal in number to all those which could possibly be examined at the present time.

These impressive numbers shrink into a smaller compass when the total *light* of the stars is considered. It may readily be shown that if the formula for N_m is correct, the total intensity I_m of all the stars brighter than magnitude m can be represented by an expression identical in form with that for N_m; but whereas the peak for the error curve, the integral of which represents N_m or I_m, is in the former case (C = 23 or 24) beyond the limits of the observed data, in the case of I_m it is well within these limits—in fact, half the total light of the stars comes from those brighter than about $9·5^m$. Up to this point the light received from all the stars of magnitude m to $m+1$ increases; beyond this it diminishes rapidly, the increase in the number of the faint stars, great though it is, being insufficient to counterbalance their diminished brightness. Owing to the formula for N_m giving too small a number of bright stars (a defect of little moment for most values of m, in the case of N_m, but of serious importance when the total light of the stars is under consideration), the following table has been constructed from Table I., in order to give the actually-observed light of the stars so far as magnitude 17, the formula being used only beyond this point, where it is quite sufficiently accurate for the purpose. The light is given in terms of the number of first magnitude stars of equivalent intensity. Three very bright stars are given individually.

TABLE II.—*The Equivalent Light of the Stars.*

Magnitude	Number	Equivalent number of 1st magnitude stars	Totals to magnitude *m*
−1·6	Sirius	11	—
−0·9	α Carinæ	6	—
−0·0	α Centauri	2	—
m m			
0·0–1·0	8	14	33
1·0–2·0	27	17	50
2·0–3·0	73	18	68
3·0–4·0	189	19	87
4·0–5·0	650	26	113
5·0–6·0	2,200	35	148
6·0–7·0	6,600	42	190
7·0–8·0	22,550	56	246
8·0–9·0	65,000	65	311
9·0–10·0	174,000	69	380
10·0–11·0	426,000	68	448
11·0–12·0	961,000	60	508
12·0–13·0	2,020,000	51	559
13·0–14·0	3,960,000	40	599
14·0–15·0	7,820,000	31	630
15·0–16·0	14,040,000	22	652
16·0–17·0	25,400,000	16	668
17·0–18·0	38,400,000	10	678
18·0–19·0	54,600,000	6	684
19·0–20·0	76,000,000	3	687
All stars fainters than 20^{m}·0		3	690

It appears that the total light of the stars is approximately equal to that of 700 first magnitude stars. Previous estimates of this number have greatly erred on the side of excess (more than three times the present value having been given, though these estimates should be reduced by about 20 per cent. for comparison with the present one, since they have been expressed in terms of first magnitude stars on the visual scale). The present value can scarcely be much affected by our ignorance as to the exact numbers of stars fainter than 17 *m*, as it is a fairly safe deduction from the above formulæ that the stars fainter than 15 *m* contribute less than one-eighth of the total light. Indeed, the fainter half of the stars, several hundred millions in number, account for only ¼ per cent. of the total light, about equal to that of four second magnitude stars. It may be of interest, in conclusion, to express the total light of the stars in terms of the light of the full moon and of the standard candle; using some Harvard data for the brightness of these two sources of light, it appears that the full moon is very nearly one hundred times as bright as a star of magnitude −6·1, the light of which would equal the combined light of all the stars, while light of the same intensity would be received from an ordinary 16-candle-power electric lamp at forty-five or fifty yards distance.

S. CHAPMAN.

THE STONE TECHNIQUE OF THE MAORI.[1]

THE Maori have long been famous as past masters in the art of working stone, the ornaments and implements of the beautiful nephrite ("jade") of New Zealand being especially noteworthy. It is, therefore, with peculiar pleasure that we welcome the appearance of a monograph which deals in an adequate manner with this important subject; indeed this is the only complete account we have of stone technique in Oceania. The student must not overlook, however, the beautifully-illustrated monograph on "Ancient Hawaiian Stone Implements," by W. T. Brigham (*Mem. Bernice Pauahi Bishop Museum*, vol. i., No. 4, 1902), in which many implements from New Zealand are figured.

FIG. 1.—Unfinished adze-blade of very fine-grained black aphanite, illustrating the fine symmetrical form attained under the processes of flaking (or chipping) and bruising, without any grinding whatever. The tool could be utilised as an adze if only the lower part of the blade were ground. Length 12½ in. This is also a common Hawaiian type.

The preparation of the present memoir could not have been entrusted to a more competent student, as Mr. Elsdon Best has gained a deservedly high reputation for his intimate and sympathetic knowledge of the ancient lore of the Maori, and for his acquaintance with the literature of all that pertains to New Zealand. An authoritative account is given of the native terminology for the various kinds of implements and of the stones employed for the blades, as well as of the methods for the manufacture of the ordinary stone tools, the information being culled from numerous published sources and from the natives themselves. There is a certain amount of *tapu* pertaining to the task of cutting nephrite and no woman was allowed to come near the workers, but there was no *tapu* in connection with the working of any other stone. Holes were drilled in stone by means of the cord drill, but the bow drill (with or without a mouthpiece) and the pump drill seem to have been unknown to the Maori in pre-European times. The same appears to hold good for Polynesia, though it is not easy to see how the pump drill of New Guinea could have been introduced by Europeans. Having chipped and bruised his implement into the desired form,

[1] Dominion Museum Bulletin No. 4. The Stone Implements of the Maori. By Elsdon Best. (Wellington: J. Macay, Government Printer, 1912.)

the Maori had then to smooth the surface by rubbing it on a piece of sandstone, usually in a longitudinal manner, as he had no knowledge of a rotatory stone for this purpose.

The methods of hafting the implements are described and evidence is adduced to show that, contrary to what was formerly believed, the Maori did use tools helved as axes, but they were not nearly so numerous or commonly used as were tools hafted and used as adzes.

All the available information about nephrite and the tools made from it is summarised by Mr. Best. Many legends have grown up in connection with this precious stone, for this there has been ample time, since "Polynesians, or a mixed people, must have been settled in New Zealand for at least one thousand years, and possibly for a longer period. It is also highly probable that the old-time people of these isles, who here flourished long before the immigration of *circa* 1350, were acquainted with nephrite of the South Island, and also that they worked it to some extent." The memoir is illustrated by fifty-one plates which leave nothing to be desired.

A. C. HADDON.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 6.

THE Faraday lecture of the Chemical Society will be delivered by Prof. Svante Arrhenius in the theatre of the Royal Institution on Monday, May 25, upon the subject of "Electrolytic Dissociation."

DR. ROBERT CHODAT and Dr. Richard Wettstein, Ritter von Westersheim, have been elected foreign members of the Linnean Society. The council of the society has decided to award the Linnean medal at the forth coming anniversary meeting on May 25 to Prof. Otto Bütschli, of Heidelberg.

A REUTER message from Ottawa states that an Order in Council has been passed setting aside as a national park an area of ninety-five square miles situated within the railway belt of British Columbia, in the vicinity of Mount Revelstoke, on the line of the Canadian Pacific Railway. It will be known as the Revelstoke National Park.

THE death is announced, on May 15, of Miss Ida Freund, late staff lecturer at Newnham College, and author of several papers on chemical subjects, as well as of a valuable work published in 1904, entitled "The Study of Chemical Composition: an Account of its Method and Historical Development."

DR. J. C. KONINGSBERGER, director of the Botanic Gardens—'s Lands Plantentuin—Buitenzorg, Java, informs us that the new laboratory for foreign scientific visitors is now open. The laboratory is consecrated to the memory of his predecessor, the late Prof. Melchior Treub, and consequently bears the name "Treub Laboratorium." We are asked to announce that, as hitherto, the director and staff of the gardens welcome visitors, and will do all that is in their power to make a scientific voyage to Java and a stay in Buitenzorg as profitable as possible.

THE annual meeting of the British Science Guild will be held at the Mansion House to-morrow, May 22, at 4 p.m., the Right Hon. the Lord Mayor presiding. Sir Ronald Ross, K.C.B., will deliver an address, and other speakers will be the president of the guild (the Right Hon. Sir William Mather), Sir Boverton Redwood, Bart., the Right Hon. Lord Blyth, Sir William Beale, Bart., Mr. C. Bathurst, M.P., Major O'Meara, C.M.G., Mr. Alexander Siemens, and Mr. Carmichael Thomas. The dinner of the guild will be held on the same date, at 7 p.m., at the Trocadero Restaurant, under the chairmanship of Sir William Mather.

THE President of the Board of Agriculture and Fisheries has appointed a Departmental Committee to consider and report upon the effect of the present arrangements for the sale of the small-scale maps of the Ordnance Survey. The Committee consists of Sir Sydney Olivier, K.C.M.G., Permanent Secretary of the Board of Agriculture, chairman; Mr. F. Atterbury, C.B., Controller of his Majesty's Stationery Office; and Colonel C. F. Close, C.M.G., Director-General of the Ordnance Survey. Mr. J. L. Bryan, of the Board of Agriculture, will act as secretary to the Committee.

THE young of the grey seal (*Halichoerus grypus*) are stated to differ from those of all other European seals by their inability to swim until several weeks after birth; and as they are born above high-water mark on rocks and skerries in the open sea, they are peculiarly liable to destruction by those acquainted with the haunts and habits of the species. Despite the small value of the pelt of the pup and of the oil of the parent, expeditions have of late years been made to the breeding-places of these seals on the British coasts, with the result that the species is in jeopardy of imminent local extermination. To put matters on a better footing a Bill has been introduced in the House of Lords to enact an annual close time for these seals from October 1 to December 15; it recently passed the third reading in the Upper House.

AT the beginning of this year the *Biologische Versuchsanstalt* at Vienna passed into the possession of the Imperial Academy of Sciences. The institution is for the experimental investigation of organisms, especially experimental morphology and developmental physiology; also of comparative physiology and the borderlands of biophysics and biochemistry. The Academy of Sciences has appointed a committee of trustees for the institution. A limited number of tables is exempt from fees, and may be awarded by the director of the Anstalt or directors of its departments. The Austrian Ministry of Education has reserved four tables of which as a rule one is to be awarded in every department. Applications for research tables may be addressed to the director of the Anstalt, or to one of the following directors of departments:—*Botany*, W. Figdor and L. v. Portheim; *Physical Chemistry*, W. Pauli (until December 31, 1914); *Physiology*, E. Steinäch; *Zoology*, H. Przibram.

THE annual meeting of the Société Helvétique des Sciences naturelles is to be held at Berne on August

31–September 3 next. Prof. E. Fischer is the president for the year, and Dr. H. Rothenbühler is the secretary of the committee of management. The following addresses to general meetings of the society have been announced:—Dr. Bluntschli, of Zürich, on the biology and ontogeny of the primates of the New World; Prof. E. Hugi, of Berne, on the geology of the Gaster range and the Lötschberg tunnel; Prof. Kohlschütter, of Berne, on physico-chemical factors in the origin of natural forms; Prof. Noelting, of Mulhouse, on the synthesis of colouring matters; and Prof. H. Sahli, of Berne, on the influence of natural science on modern medicine. The Swiss Mathematical, Physical, Chemical, Geological, Botanical, and Zoological Societies will also hold their annual meetings at Berne on September 2. Members desirous of presenting papers at any of the meetings of sections should communicate with Prof. Fischer, Kirschenfeldstrasse, 14, Berne, before July 1.

ON Monday last a Committee of the House of Lords threw out a Bill promoted by the Glasgow Corporation under which they sought powers to make an electric tramway with a double line of rails along University Avenue, which for nearly half a mile forms the northern boundary of Glasgow University and of the Infirmary. The University opposed the Bill on the ground of magnetic disturbance and vibration, which would adversely affect the physical, botanical, and biological laboratories. Technical evidence was given in support of the opposition by Profs. Gray, Kerr, and Bower, of Glasgow University, Prof. Nuttall, of Cambridge, and by Mr. C. V. Boys and Mr. Sellon. This decision is one of the first importance for the protection of our universities from encroachments upon their amenities and the quiet which they have enjoyed; it is necessary for their welfare, and will establish a useful precedent when town councillors and other promoters are trying to force their schemes regardless of the injury which they would do.

IN the issue of the *Revue générale des Sciences* for December 30, 1909, an article by M. Ernest Solvay was published dealing with "Physical Chemistry and Psychology." In that article M. Solvay propounded ten questions which opened up numerous researches; and to encourage investigation in these directions he announced that he would devote 2000*l*. to the award of prizes for work designed to answer his questions. The theses had to be sent in by January 1, 1914, to the Institut Solvay de Physiologie in Brussels. The awards were made by a commission consisting of Prof. L. Fredericq, of Liége, Prof. J. Verschaffelt, of Brussels, and Prof. O. Dony-Hénault, of Mons, and were announced in the issue of our contemporary for April 30. The prizes were awarded as follows:—To Prof. G. Bredig, of the Technical High School, Karlsruhe, for his researches on catalysis; to M. G. De Meyer, of the Institut Solvay, for his work on muscular action; and to M. J. Boselli, of Paris, for his research on the speed of reaction in heterogeneous systems.

THE plans for the Meteorological Conference which is to be held in Edinburgh in September next are taking definite shape. A strong general committee with seventy-six members has been formed. The lamented death of Sir John Murray has left the office of president vacant. The other officers of the conference are the following: *Vice-presidents*: C. J. P. Cave, president of the Royal Meteorological Society; J. Mackay Bernard, of Dunsinnan, president of the Scottish Meteorological Society; Major-General Ruck, president of the Aeronautical Society; Dr. W. N. Shaw, director of the Meteorological Office; Dr. H. R. Mill, director of the British Rainfall Organisation; Sir William Turner, principal of Edinburgh University; the Right Hon. Robert K. Inches, Lord Provost of Edinburgh. *Treasurer*: Captain H. G. Lyons. *Hon. Secretary*: F. J. W. Whipple, Meteorological Office, South Kensington, S.W. *Convener*, Edinburgh committee: Dr. E. M. Wedderburn, 2 Glenfinlas Street, Edinburgh. The programme of the conference, which will open on Tuesday, September 8, includes general discussions on meteorological questions, such as the use of pilot balloons for forecasters and aeronauts, wireless telegraphy in relation to forecasting, the electricity of thunderstorms, and evaporation and rainfall, as well as two evening lectures, which will probably be open to the public, a reception to which the members have been invited by the Lord Provost of Edinburgh, demonstrations with sounding balloons, and an excursion to Eskdale Observatory. Further particulars may be obtained from the hon. secretary, at the Meteorological Office, South Kensington.

IN the University of California's Publications on American Archæology and Ethnology, vol. x., No. 6, Mr. P. E. Goddard contributes notes on the Chilula tribe of Indians, who up to recent times inhabited the banks of Redwood Creek, Humboldt County, California. They have now ceased to exist as a separate people, and if a full account of the tribe were possible its chief interest would be found in the deviations from the Hupa type of culture due to environmental differences, and certain transitional features. A curious discovery is that of a pond round which the girls during their adolescence ceremonies used to run in a direction contrary to the course of the sun. If the girl was able to run once round without drawing breath it was assumed that she would be a good basket-maker.

IN the April number of *Bedrock* Prof. G. Elliot Smith replies to certain criticisms tending to belittle the morphological importance of the Piltdown skull (*Eoanthropus dawsoni*). After remarking that, in spite of his relatively high brain-development, his face still retained many ape-like traits, the author goes on to observe that "the Piltdown man is the nearest approximation that has yet been discovered to the direct ancestor of the genus Homo, and all of its many varieties that made their appearance in Pleistocene and more recent times." In a later passage he adds that "it must be regarded as definitely settled, with as high a degree of probability as any question of phylogeny can be said to be settled, that the genus Eoanthropus represents the immediate ancestor of the genus Homo."

IN *Man* for May Mr. Eldon Best discusses the question of the peopling of New Zealand. He thinks it is going too far to speak of two distinct races in the island; but we have certainly the blending of two races: the fair-skinned Polynesian, with good features, and the swart, thick-lipped, flat-nosed Melanesian type. The former has hair with a slight wave in it; the hair of the latter, if allowed to grow, has the frizzy and bushy appearance of that of the Fijians. Between them is an intermediate type, the result of blending. Besides these, again, in the Urukehu strain we find a fair-haired, light-skinned type, the origin of which is still a mystery. Cannibalism, he supposes, was by no means a common custom in the Society group, whence the Maori came to the island; but it was well established in Fiji, and was probably introduced by the Maruiwi—a folk with pronounced Fijian affinities—and was thus acquired by the Polynesian Maori, or rather, was inherited by the mixed descendants of these two peoples.

THE current number of the *Quarterly Review* contains an interesting account of the family of Sadi Carnot from the pen of Mr. James Carlill. Sadi himself was a captain of engineers, and died in 1832 when only thirty-six, having published his "Reflexions sur la puissance motrice du feu" in 1824. He was the eldest son of General Lazare Carnot, the "organiser of victory" of the first Republic, and member of the Committee of Public Safety. His younger brother Hippolyte became Minister of Education in, and his nephew Sadi President of, the French Republic (1887). His uncle Feulint was almost as distinguished a soldier as his father, and three other uncles became judges, one of the Cour de Cassation. His grandfather was a distinguished notary of Nolay in Burgundy, and his grandmother a woman of great beauty. Families of ten, twelve, or fourteen members are common in his pedigree. According to the author, the family mind, which enabled the Carnots for a century and a half to supply men to fill the highest offices in the State, was the normal brain encouraged from childhood to take an active interest in everything, and invigorated by constant use.

THE fishes collected during the Duke of Mecklenburg's first expedition to Central Africa are described by Messrs. P. Pappenheim and G. A. Boulenger in vol. v., Zoologie iii., Lief. 2, of the *Wissenschaftliche Ergebnisse* of the expedition, published at Leipzig by Klinkhardt and Biermann. A new genus (Schubotzia) of cichlids and a number of new species of various groups are named. The same publishers are also issuing the scientific results of the Duke's second expedition ("Ergebnisse der Zweiten Deutschen Zentral-Africa Expedition, 1910–11," etc., etc.), of which we have received Lief. 2 of the zoological section of the first volume, dealing with the copepod and cladocerotine crustaceans.

THE whole of vol. xxv. of *Anales del Museo Nacional de Historia Natural de Buenos Aires* is devoted to the mammalian Tertiary faunas of the "Araucanian" formations of Argentina, as specially represented by those of Monte Hermoso and the Rio Negro, the monograph being illustrated by thirty-one plates and ninety-two text-figures. The author, Señor Cayetano Rovereto, records a very large number of species, some of which are described as new, and likewise names several new genera. Most, at any rate, of the forms belong to types already familiar through the works of Ameghino, Dr. W. B. Scott, and others, and it may be a question whether at least some of the generic types described as new are not based on trivial characters or on those due to immaturity.

OF late years it has been very generally accepted both in this country and on the Continent, that the name "auerochs," or "aurochs," belongs of right to the extinct wild ox, or ur (*Bos taurus, primigenius*), and not to the bison (*B. bonasus*). This, we believe, was first definitely pointed out in this country on p. 14 of a paper on the zoology of ancient Europe read by the late Prof. A. Newton before the Cambridge Philosophical Society in 1862, and published later on in the same year by Messrs. Macmillan in pamphlet form. The writer's actual words are that the ur or urus "has been so very commonly confounded by writers with the zubr, or European bison (*B. bonasus*)—the aurochs, as it is commonly, although erroneously, called in France and England, that it is not easy to make out anything with certainty with regard to it." A similar view, adopted by others of his countrymen, was subsequently expressed in Germany by the late Prof. A. Nehring, who considered that the name auerochs was gradually transferred centuries ago to the wild ox, as the latter became exterminated. Recently Dr. B. Szalay, of N.-Szeben-Hermanstadt, in an article published in vol. vi. of *Zoologische Annalen* (p. 54), controverts this view, and maintains that the term auerochs properly belongs to the bison or zubr. To discuss the merits of the question in this place is impossible, but we may quote the legends to Herberstein's sixteenth-century pictures of the wild ox and the bison, which are respectively as follows:—"Ich bin der Urus welchen die Polen Thur nennen, die Deutschen Auerox, die Nichtkenner Bison," and "Ich bin der Bison, welchen die Polen Subr nennen, die Deutschen Wysent, die Nichtkenner Urochs." Again, we have the statement by Herberstein, as summarised by Prof. A. Mertens (*Abh. Mus. Magdeburg*, vol. i., p. 7, 1906), "dass der Ur, der dort mit einheimischen Namen Thur genannt wird, bei den Deutschen Auerochs heisst."

ATTENTION was directed to the interesting excursions of the *Oberrheinischer geologischer Verein* in NATURE of May 30, 1912 (vol. lxxxix., p. 328). The *Jahresbericht* of the society for March, 1914, gives the programme of an April visit to the Vorarlberg area. The same number contains a paper on the origin of the Black Forest and the Vosges, by Paul Kessler, which will be welcomed on account of its systematic treatment of a long series of events. The thirteen sections, illustrating the region now occupied by the trough-valley of the Rhine, from the close of Devonian times to the present day, are worthy of reproduction as diagrams for class-instruction. The most mountainous condition of the region, when it resembled the present Alpine chain, is shown as resulting from the Armorican folding. Immense intrusions of igneous rocks then took place, and some of the gneisses of the Vosges and the Black Forest are now recognised as granites of Carboniferous age. While the great lowering of the Rhine-trough by down-faulting dates from Middle Oligocene times, and while this was emphasised by the Miocene uplift of its flanking walls, it is interesting to reflect that the Rhine itself played no part in the modification of the valley until it flowed for the first time northward at the opening of the Glacial epoch.

SINCE the description by Prof. Malladra, in May, 1912, of the existence of a practicable path by which the bottom of the Vesuvian crater can be reached, several observers have availed themselves of the opportunity of making investigations concerning volcanic action under these unique conditions. In the *Geologische Rundschau* (Band v., Heft 2, 1914) a very interesting account of a visit to the crater is given by Mr. Max Storz, of Munich. Among the valuable results published as the outcome of this visit, we may direct attention to the temperature observations, made by means of metallic wires with different melting points, and to the determination of the acids and bases present in the emanations. The acids found were hydrochloric and sulphurous-acid gases, and indications of the following metals were detected—lead, copper, calcium, magnesium, potassium, and sodium. Useful plans of the crater and of the bocca at its bottom are given, together with photographs which are similar in every respect to those obtained by Mr. Burlingham, three of which appeared in NATURE of February 5.

THE Californian earthquake of 1906 originated in a movement along the San Andreas fault-rift extending over a distance of 290 miles. Since that year three slight earthquakes have been traced to slips along the same fault. The first, on September 12, 1912, occurred near the south end of San Francisco Bay; the second, on October 25, 1913, to the north-west of Berkeley; the third, on January 23, 1914, in an intermediate position close to San Bruno. The epicentre of the last was determined by Mr. E. F. Davis (Bull. Seis. Soc. America, vol. iv., pp. 25–28) by means of Omori's formula for local shocks from the duration of the preliminary tremors at the Lick, Santa Clara, and Berkeley Observatories.

THE report for 1913 of the Stonyhurst College Observatory (Lancs.) has been received from Father Sidgreaves, and contains *inter alia* mean and extreme meteorological values at that important station for the last sixty-six years. The observatory has recently severed its principal connection with the Meteorological Office (as explained in the last annual report of the meteorological committee), but it still furnishes the latter body with weekly reports; the automatic recorders remain at Stonyhurst, and their continuous registrations are uninterrupted.

THE yearly report for 1913 of the *Deutsche Seewarte* (Hamburg) bears witness to the great activity of that useful institution with regard especially to (1) maritime meteorology, (2) weather telegraphy, and, generally speaking, to all matters connected with the welfare of the seafaring community. Much attention is given to the proper installation of the mariner's compass, and to the application of the theory of magnetism to navigation; these matters also engaged the earnest attention of the late Dr. v. Neumayer. During the year the number of complete sets of observations received from observers at sea exceeded three-quarters of a million. These are utilised in the preparation of monthly meteorological charts, sailing directions, and daily synoptic weather charts of the North Atlantic. The daily report has undergone several recent improvements, and it now includes small charts showing separately the changes of air-pressure during the preceding day and night by lines of equal values of these changes (isallobars); these values are fully discussed by Dr. N. Ekholm in No. lxiv. of the publications of the international council for the study of the sea (NATURE, September 18, 1913).

BOLTZMANN'S formula for entropy considered in relation to the theory of probability has recently been made the basis of many of our modern radiation theories; but objections have been raised by Einstein and others, in particular to the validity of the formula when applied to systems other than isolated systems the energy of which is constant. A short note on this question is published by Dr. Karl F. Herzfeld in the Vienna *Sitzungsberichte* for 1913 (recently received), in which the author confirms the more general formula according to which the entropy in any state is proportional to the logarithm of the number of possible cases plus a constant, but the value of this constant is not definite, as it was in the usual Boltzmann formula.

A SHORT time ago Mr. Jenkins described (*Philosophical Magazine*, vol. xxvi., p. 752) a method devised by Prof. Hicks for determining a magnetic field, in particular the horizontal component of the earth's field, by a method which reduced the measurement to that of an electric current. In the case of the earth's field a solenoid through which a measured current flows is used to reverse that field. The state of the joint field is judged by the time of oscillation of a small magnet at the centre of the solenoid. In the March number of *Terrestrial Magnetism*, Prof. Schuster describes a similar method which he has had tested at the National Physical Laboratory. It seems probable that when the coil is wound with the degree of accuracy used in current-measuring instruments, the accuracy of a determination will be at least as great as with the Kew magnetometer, and the time required will be five minutes instead of an hour.

AN electrical sterilisation process has been in successful operation at one of the milk depôts of the Liverpool City Corporation for the past six months, and a report on this process drawn up by the city bacteriologist, Prof. Beattie, was presented last month to the Health Committee of the City Corporation. The process depends upon the use of an alternating current of high potential for destroying, by shock, the bacteria contained in the milk. The sterilising apparatus consists of a long tube with copper electrodes inserted in tube-shaped depressions at suitable points, the milk being passed continuously through this tube, from a raised tank, at a predetermined rate of flow. The current used varies from 2 to 3 amperes at an E.M.F. of 3900 to 4200 volts, and each unit quantity of milk is exposed to the action of this current for such a brief period of time, that no heating effects are produced. Details of the bacteriological results are given in the report, from which it is seen that *B. coli* and the ordinary milk-souring bacteria have been invariably absent from the electrically-treated milk, and that the average percentage reduction in the number of total bacteria, over a period of fifteen days' operation of the plant, was 99·93 per cent. The electrical sterilising apparatus in use at the Earle Road Milk Depôt of the Liverpool Corporation has a capacity of 125 gallons of milk a day, and this quantity is distributed in 3000 bottles. The question of extending the plant is now being considered.

A PAPER on recording pyrometers, read by Mr. C. R. Darling at a meeting of the Faraday Society on April 22, was accompanied by a full display of the most recent types of instruments. The marked improvement which has been effected in the accuracy of these instruments was attributed by the author, and by several speakers in the subsequent discussion, to the admirable work of the National Physical Laboratory as an impartial standardising agency. Some recent advances include (1) the introduction of electric power to operate the pyrometers, either by means of relay-circuits or in place of clockwork, in such a way that the automatic control of large technical furnaces may easily be provided for; (2) arrangements whereby the same instrument may be used either with a resistance thermometer or with thermal couples; (3) automatic switches with the help of which the records from several furnaces may be recorded by the same machine.

THE Chemical Society's journal for April contains two papers by Dr. Pickard and Mr. Kenyon on the dependence of rotatory power on chemical constitution. The first paper, recalling the monographs of Sir William Perkin on magnetic rotatory power, contains a description of no fewer than seventy-three optically-active esters of the fatty series. Unlike the alcohols from which they are derived, which exhibit the simplest type of rotatory dispersion at all temperatures, the esters show marked deviations from the simple law when the temperature is raised; in certain solvents they even exhibit anomalous rotatory dispersion. The second paper includes a description of the optical properties of naphthyl methyl carbinol $C_{10}H_7.CH(OH).CH_3$. This substance obeys the simple dispersion law at temperatures above 160°, but shows anomalous rotatory dispersion in the superfused condition at temperatures below about 10°. It is suggested that the anomalous dispersion is caused by the actual presence in the superfused liquid of two of the hypothetical varieties of the naphthalene nucleus which have long been postulated by organic chemists.

THE transportation problem in Canada, and Montreal Harbour, were discussed in a paper read at the Institution of Civil Engineers on April 7 by Mr. F. W. Cowie. It appears that the farmer receives for his wheat 67 per cent. of the price paid by the consumer; the remaining 33 per cent. represents the cost of transportation, handling, and selling profits. It is important that the latter percentage should be reduced to the lowest possible figure, so that the farmer may receive the full due for his toil, and the cost of living in Great Britain may not be unduly enhanced. Montreal Harbour handled sixty million bushels of grain in 1913, and nearly a hundred million bushels of Canadian grain were shipped in the same year through Buffalo in the United States. The loss to Canadian transportation and selling organisations by reason of the latter shipments amounts to about 18,000,000 dollars. The magnificent railway systems between New York and Buffalo are the most powerful rivals of the "all Canadian" routes. Great efforts are being put forth by the Canadian Government and others interested to improve facilities and render available Canadian routes. The author is of the opinion that the advantages for future transportation should lie with the St. Lawrence route. It is believed that improvements for the storage and handling of grain in the ports of Great Britain are not advancing in measure equal to the Canadian ports.

SIX new volumes have been added to "The People's Books," which Messrs. T. C. and E. C. Jack are publishing at sixpence net each. The additions fully maintain the high standard of this excellent series, which is bringing within the reach of all readers the results of modern studies in many branches of human knowledge. Particular attention may be directed to Dr. W. E. Carnegie Dickson's little book on bacteriology, and Mr. Ford Fairford's on Canada. Dr. Dickson, in the sub-title to his volume, "Man's Microbe Friends and Foes," sufficiently describes the point of view from which he has written. He gives a brief historical summary of the growth of the science, explains the relation between health and disease, describes some of the commoner organisms which produce disease, and explains the importance of bacteria in the arts and industries. Mr. Fairford's book should prove of service to students of commercial geography, and interest general readers in an important part of the Empire.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A Kiel telegram, dated May 17, reports the discovery of a new comet, stated to be of the fourth magnitude, by Zlaitinsky. On May 15 the comet was situated close to η Persei, while on the following day it was recorded as being half a degree north of α Persei.

A further telegram from Kiel communicates an observation by Prof. Schorr. On May 16, at 11h. 12·9m. Bergedorf mean time, the comet was of the 4th magnitude, and its position was R.A. 3h. 17m. 37s., declination +49° 51′ 7″.

TELESCOPIC METEORS.—One of the interesting contributions to the *Observatory* for May is an account by Mr. W. F. Denning of observations of telescopic meteors. Thirty years ago Mr. Denning directed attention to the importance of making combined observation of these bodies, for he and others were of the opinion that these faint shooting stars were at vastly greater distances than those visible to the naked eye, for their slowness of movement and diminutive size suggested such remoteness. While ordinary meteors rarely become visible at a greater height than about 100 miles, these telescopic objects require distances of 1000 to nearly 2000 miles to explain their appearance assuming as standard the ordinary velocity and length of flight of naked-eye meteors. From four objects Mr. Denning inferred heights of 1260 to 1820 miles, and these he states were "only examples of a class and not rarities." The whole question is interestingly summarised in this contribution, and the author describes in detail observations extending over the period 1881 to 1902, and reproduces numerous diagrams of various forms of trails observed.

A NEW PHOTOGRAPHIC CHART OF THE MOON.—In the April number of *L'Astronomie*, M. Camille Flammarion gives an account of the new photographic chart of the moon, which has recently been prepared by M. C. Le Morvan. M. Le Morvan during the last eighteen years has been associated with the production of all the plates for the great atlas of Loewy and Puiseux, and this important and unique collection of clichés, taken with the Paris equatorial coudé, provides him with a rich assortment of material. The object of the work is to provide in a more convenient form as perfect a representation of the lunar surface as is possible in every detail. The plates are reproduced in héliogravure, and are issued in two parts, each part consisting of twenty-four sections, and representing increasing and decreasing phases respectively. The publication of this chart is rendered possible by a grant of 4000 francs out of the Bonaparte funds by the Académie des Sciences. M. Le Morvan communicates also a brief account of the construction of lunar charts.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held on Wednesday, May 13, and was, as usual, largely attended. During the evening demonstrations were given in the meeting-room by Prof. J. P. Hill and Mr. P. Schilowsky. Prof. Hill gave a short account of the work of the Percy Sladen Expedition to Brazil, 1913, illustrated by lantern-slides of material collected and regions visited; and Mr. Schilowsky demonstrated the application of gyroscopes to locomotion on land, on sea, and in air. The gyroscope's stabilising property can be applied to unstable bodies like monorail cars or monotrack automobiles, making them stable; that property can be used for stable but oscillatory bodies like ships, submarines, flying machines, preventing their rolling movement and rendering them perfectly steady. A description of the application of the system to a two-wheeled motor-car appeared in NATURE of May 7 (p. 251). Dr. J. G. Gray exhibited gyrostats with accessories for showing the more obvious properties of the gyrostat, and a series of what may be called "animated" gyrostats. The latter consist of gyrostatic acrobats, bicycle riders, and gyrostatic motor-cars, both two-wheeled and four-wheeled. A two-wheeled car was provided with a gyrostatic "chauffeur," which stabilised the car and presided at the steering wheel. This car illustrated the action of directing and stabilising apparatus for use on torpedoes, airships, and aeroplanes. A further form of two-wheeled car demonstrated methods of stabilising and manœuvring an airship by means of forces derived from the propellers, which apply a direct push to the moving body. Dr. Gray's bicycles and motor-cars can be steered by the wireless transmission of electrical action. There were many other exhibits of objects and devices of scientific interest, and we give descriptions, from the official catalogue, of some of the most interesting grouped according to related subjects.

The Astronomer Royal: Transparencies of the Milky Way (selected from the Franklin-Adams chart). The whole sky was photographed on 206 plates by the late J. Franklin-Adams. The plates have been presented to the Royal Observatory, and the number of stars of different magnitudes from the 12th to the 17th have been determined. There are altogether fifty-five million stars on the plates, and from the sequence of the numbers for different magnitudes it is shown (S. Chapman and P. J. Melotte, Mem. R.A.S., vol. lx.), that the total number of stars in the sky is not less than 1000 millions, and cannot much exceed twice this amount, and that half the stars are brighter than the 23rd or 24th magnitude. *Mr. George H. Cobb:* A terrestrial globe, dated 1620, constructed to serve as a timepiece; supported by a gilt bronze figure of Atlas. Inside the globe is a movement of the verge type, so geared to the axial spindle that the globe revolves once in twenty-four hours.

The National Physical Laboratory (Mr. F. E. Smith): Photographic record of the variations in the horizontal intensity of the earth's magnetic field at the National Physical Laboratory. The record shows the variations in H from 1 p.m. on Saturday, April 19, to 11 a.m. on Sunday, April 20. The time scale (abscissa) is 43 cm. to the hour (7 mm. to the minute), and the intensity scale (ordinate) is 2·5 mm. for a change in H of 1γ (0·00001 c.g.s. unit). The sudden variations are principally due to the earth currents produced by the London United Electric Tramway system. These sudden changes are not in general greater than 5γ. *Mr. W. A. Douglas Rudge:* Electrification produced during the raising of a cloud of dust. During the raising of a cloud of dust by almost any method, considerable charges of electricity are produced. A charge of one sign is found upon the dust itself, and another charge of opposite sign, either upon the air, or else upon fine particles of dust which remain suspended in the air. Generally, dust of an acidic nature, such as silica or molybdic acid, give a negative charge to the air, metallic oxides and organic bases give positive charges to the air.

Dr. J. A. Fleming: An apparatus for the production of stationary vibrations on strings, loaded and unloaded. Various arrangements have been employed for the production of stationary vibrations on strings to illustrate the laws of wave motion. The apparatus exhibited consists of an electric motor having on one end of its shaft a counting mechanism, and on the other a disc to which is fixed a pin carrying the end of a rocking lever This lever has on it a hook to which a string can be attached. The other end of the string is fixed to a slide rest arrangement, by means of which any required tension can be put on the string. When the motor revolves it gives to one end of the string an irrotational motion in a circle and propagates waves along the string. By adjusting the tension these waves can be made stationary. By employing a cotton cord, either single or multiple, in various degrees, it is easy to prove the fundamental laws of wave motion along cords. By using strings loaded with glass beads the effects of reflection at loads, or the laws of vibration of loaded cords, can be shown. *Mr. W. Duddell:* Water model of the electric arc. One of the essential properties of the electric arc is that, when the current through the arc increases, the potential difference between its terminals decreases. The model exhibited consists of a mushroom valve. The pressure tending to reseat the valve is so arranged that it diminishes very rapidly as the valve lifts. In this way, when the flow of water is increased through the valve, the difference of pressure between its two sides decreases and thus represents one of the properties of the electric arc. When a steady flow is established and a column of water having a definite periodic time is connected to the valve oscillations can be set up similar to those obtained with an electric arc. Other properties of the arc discharge can also be demonstrated.

The Cambridge Scientific Instrument Co.: An aerodynamic balance. Designed for the experimental investigation of the stability of aeroplanes. The main part of the balance consists of three arms mutually at right angles, each arm being counterbalanced. These arms meet in a point at which a steel centre is fixed, and the weight of the balance is taken on this point. The vertical arm passes through the underside of a wind channel and supports the model under test. The horizontal arms are arranged respectively parallel and at right angles to the wind direction. The arrangements allow of the measurement of the forces on the model along three fixed rectangular axes, and also of the three moments about these axes for any angle of incidence of the wind on the model. *Mr. F. W. Aston:* A simple microbalance for the determination of the densities of small quantities of gases. The balance is made entirely of fused quartz, and consists of a beam of the simplest possible construction, bearing at one end a small closed bulb and at the other a solid counterpoise. The whole is supported by a knife edge working on a polished quartz plate. The system is made to balance in air at some convenient pressure, and its sensitiveness made extremely high, turning at about one-millionth of a milligram. The gas is admitted to the balance case and the pressure determined at which it causes the beam to balance in a given position. The corresponding pressure for a gas of known density (*e.g.* oxygen) is then measured, the ratio of the pressures giving the inverse ratio of the densities.

Mr. E. Leitz: A new binocular microscope. The body consists of a flat casing containing the system of prisms. At the upper end are situated two eyepieces the distance apart of which can be regulated to suit the eyes of the observer by means of a milled head which actuates two levers inside the casing. The interpupillary distance can be varied between 54 and 70 mm. The eyepiece tubes slide in guides so that dust cannot enter the prism casing. The left eyepiece tube is provided with an independent adjustment to accommodate eyes of unequal vision. All kinds of eyepieces and objectives may be used, and the instrument can be employed for the same purposes as the ordinary monocular microscope. An important feature in this microscope is the parallel eyepieces which obviate the actions of accommodation and adjustment for convergence as is necessary in binocular microscopes constructed hitherto. *Prof. A. W. Bickerton:* The polyscope. A kaleidoscope rendered so optically perfect that a hundred reflections of a point or object may be seen. The angles of one are 30°, 60°, and 90°; of the other, two angles 45° and one of 90°. They produce two classes of patterns, one suitable for textile fabrics, cretonnes, etc., the other suitable for floor cloths, tiles, etc. *The Polychromide Company (The Dover Srect Studios, Ltd.):* Instantaneous photographs on paper taken in natural colour by the polychromide system. The optical separation of the natural colour of the object photographed is accomplished by means of the Hamburger-Conrady colour separation camera, which exposes three plates simultaneously—representing the red, yellow, and blue sensations in the superposed positives on gelatino-silver emulsions, which constitute the complete colour records exhibited.

The National Physical Laboratory (Dr. W. Rosenhain and Mr. J. L. Haughton): A new reagent for etching mild steel for microscopic examination. The reagent consists of an acid solution of ferric chloride containing small proportions of chlorides of copper and tin. Iron or steel sections exposed to this solution become covered with a very thin adherent layer of copper by a process of electrochemical substitution. This film of copper is deposited upon and thus darkens the ferrite areas, leaving the pearlite areas white, this effect being the reverse of that obtained with other reagents, such as picric acid.

Prof. E. W. MacBride and Mr. H. G. Newth: Double tadpoles of the frog, and double sea-urchins. The duplicity in the frog larvæ is of varying degree, and was produced experimentally. Fertilised eggs were inverted immediately upon the completion of the first cleavage-furrow, and were kept inverted until gastrulation was complete. The duplicity in the sea-urchin larvæ consists in the development of an urchin-rudiment on both sides, or of pedicellariæ on both sides, whereas the normal larva has its rudiment on the left, its pedicellariæ on the right. *Dr. W. T. Calman: Bathynella natans,* a Crustacean of the order Anaspidacea. This minute Crustacean has hitherto been known only from a solitary specimen obtained in 1882, by Prof. Vejdovský from a well in Prague. It has recently been re-discovered in a well near Basle by M. Chappuis, by whom specimens have been sent to the British Museum (Natural History). It is a blind and otherwise degenerate member of the Anaspidacea, an ancient and primitive order of Crustacea represented by fossils in carboniferous rocks of Europe and America, and by three other recent species in Australia and Tasmania. *The Zoological Department of the British Museum (Nat. Hist.):* Cast of the "paddle" or fore limb of a humpback whale. The humpback is the species of whale which has been most hunted during the last few years in Subantarctic waters. Immense numbers of these animals have been killed annually, and it can scarcely be doubted that the number will be enormously reduced unless steps are taken to control the rate of destruction. The late Major G. E. H. Barrett-Hamilton was sent to South Georgia by the Colonial Office, at the end of 1913, in order to obtain information with regard to whales and whaling in the far south. He died during the progress of his investigations. The cast shown measures 14 ft. 6 in. in length, and illustrates one of the most striking peculiarities of the humpback, the paddles of which are exceptionally long.

Dr. H. Eltringham: Preparations showing the urticating apparatus in *Porthesia similis* (gold tail moth). The female insect has long been known to possess urticating properties similar to those of the larva. It has lately been proved that the moth deliberately collects the spicules shed by its larva, and by means of a special apparatus stores them in the anal tuft. They subsequently serve as a protection for the eggs. *Prof E. B. Poulton:* A family of *Papilio dardanus,* bred by Mr. W. A. Lamborn, near Lagos, S. Nigeria. The family was bred from a captured female of the *hippocoon* form—the black and white butterfly, which is by far the commonest female form of this species in the locality. Six previous families, bred by W. A. Lamborn from the same female form, contained *hippocoon* females and no others. This, the seventh, contains approximately equal numbers of *hippocoon* and *dionysus,* a non-mimetic female form occurring, but in very small proportions, along the tropical west coast. The facts are best explained by supposing that *hippocoon* is a Mendelian recessive, *dionysus* a dominant, and that the male parent was a heterozygote.

Dr. Vaughan Cornish: Photographs illustrative of landslides and upheavals on the Panama Canal. The photographs were taken in 1910, 1912, and 1914. That of the Culebra Cut in 1910 shows an upheaval of the solid rock of the canal bottom due to unbalanced pressure of the banks. That of the Naos I. breakwater, taken in 1912, shows the upheaval of the sea bottom at a distance from the subsiding mass of the breakwater. The photographs of the Cucuracha slide, in 1914, show the downward flow of inclined strata. The ground is broken for a height of 580 ft. above canal bottom.

Mr. Charles Dawson: Lower canine tooth of the Piltdown man (*Eoanthropus dawsoni*). This canine tooth was found on August 30, 1913, near the spot where the right mandibular ramus of Eoanthropus was discovered in 1912. As it is a lower canine of the right side, is of a new form, and has been much worn by mastication, it presumably belongs to the same jaw. It is relatively large, and is shown to have completely interlocked with the upper canine, as in the apes. *Mr. R. Eliot Steel:* Palæolithic engraving of a horse on a bone from Sherborne, Dorset. The bone is part of the rib of a horse, and was found in an old heap of débris from a quarry in the Inferior Oolite, near Sherborne. It was probably derived from a rock-shelter destroyed by quarrying. *Mr. W. N. Edwards:* "Paper coal" from the Coal Measures of Central Russia. The "paper coal" forms a bed 3–4 ft. thick, over an area of several square kilometres. It is composed exclusively of the practically unchanged cuticles of a Lepidodendroid plant, with a certain amount of carbonaceous matter. It has been suggested that the preservation of the cuticles alone was due to selective bacterial action, and Renault considers that a species of micrococcus is present.

CATALYSIS IN ORGANIC CHEMISTRY.

BY the invitation of the University of London, Prof. Paul Sabatier, of Toulouse, delivered two lectures on catalysis at King's College on May 14 and 15. On Wednesday evening, May 13, he was entertained by the Faraday Society at a complimentary dinner, at which Prof. Arrhenius and Prof. Heyn, of Berlin, were also present as guests. The two lectures were delivered in French, and were illustrated by a series of experiments in which the catalytic action of nickel, of copper, of alumina, of zinc oxide, of titanium dioxide, and of thoria were shown in actual operation. Prof. Sabatier is a whole-hearted advocate of the chemical as opposed to the physical theory of catalysis. He holds that in all cases intermediate compounds are formed, *e.g.* PtO in catalytic oxidations in presence of platinum, and NiH_2 in catalytic reductions in presence of finely divided nickel. He finds ample support for his views in the totally different effects that are often produced by catalysts which are almost identical in their physical properties. Thus formic acid vapour is decomposed wholly into hydrogen and carbon dioxide when passed over zinc oxide, but into water and carbonic oxide when passed over titanium dioxide :—

$$H_2 + CO_2 \xleftarrow{ZnO} H.CO.OH \xrightarrow{TiO_2} H_2O + CO.$$

Ethyl alcohol in like manner may be converted into aldehyde and hydrogen by finely divided copper, or into ethylene and water by alumina :—

$$H_2 + CH_3.CHO \xleftarrow{Cu} CH_3.CH_2OH \xrightarrow{Al_2O_3} H_2O + C_2H_4.$$

Different catalysts also differ very widely in their efficiency in promoting any given chemical change. Alumina can be used very effectively to convert alcohol into ethylene and water, but it becomes clogged with tarry matter which cannot be burnt off without destroying the catalytic properties of the oxide; thoria, on the other hand, becomes contaminated less readily, and can be purified by ignition without losing its activity. Again, thoria is a very useful catalyst for converting acids into ketones, *e.g.* :—

$$2CH_3.CO.OH \longrightarrow CH_3.CO.CH_3 + CO_2 + H_2O;$$

but titanium dioxide is so efficient and acts at so low a temperature that it can also be used to prepare aldehydes from mixtures of fatty acids with formic acid, and esters from acids (such as formic acid) or alcohols (such as the secondary and tertiary alcohols), which lose water so easily that it is difficult to esterify them without decomposition. On the other hand, the best catalyst for preparing ketones and other derivatives from benzoic acid is ordinary chalk. A very important catalyst is manganous oxide, which can be prepared easily and cheaply from manganous carbonate, and can be used in almost every case for the preparation of ketones in place of thoria or titanium dioxide.

Prof. Sabatier laid stress on the reversibility of catalytic actions. Thus nickel will promote dehydrogenation as well as hydrogenation, and very small differences of conditions are required to cause the reversal of actions such as those which are shown by the equations :—

$$C_2H_4O + H_2 \rightleftharpoons C_2H_6O$$
$$C_6H_6 + 3H_2 \rightleftharpoons C_6H_{12}.$$

An interesting account was given of the way in which acetylene in contact with nickel at different temperatures and in presence of varying proportions of hydrogen gives rise to complex products which are in every respect identical with natural petroleums. By varying the conditions the product can be made to resemble the four chief natural types as derived from North America, from the Caucasus, from Galicia, and from Roumania. These observations suggest a theory of the origin of petroleum that has a far higher claim to acceptance than most of those that have been put forward hitherto.

Prof. Sabatier touched only lightly on the technical applications of his new methods. The vast industry which has sprung up within the last two or three years, in this country, on the Continent, and in America, was illustrated by two small samples of oils that had been hardened by the action of hydrogen in presence of finely divided nickel; reference was also made to the fact that in the process of hardening the disagreeable taste and smell of the fish-oils are completely removed.

It is not too much to say that Prof. Sabatier has introduced a new era in organic chemistry. The advantages of catalytic methods are obvious: the catalyst will last for an indefinite period unless its activity is destroyed by overheating, which is generally fatal, or by "poisonous" impurities, such as sulphur or the halogens which quickly arrest the catalytic hydrogenation of organic compounds by nickel. The only materials required are those which are essential constituents of the products, and in almost every case the first effect of the successful introduction of catalytic methods is to bring about a great reduction in the cost of production. The rapid extension of these methods is therefore a matter of great scientific and technical importance.

T. M. L.

RECENT GEOLOGICAL WORK IN AUSTRALASIA.

THE Australian Commonwealth Bureau of Meteorology at Melbourne, in its Bulletin No. 8, publishes a memoir by Griffith Taylor on the physiography of Eastern Australia, in which it is urged that a repeated shifting of the divide between the eastern coast-streams and those running towards the Darling or the interior has occurred during Cainozoic times. The former streams have in consequence been able to lengthen themselves by captures in the region of the divide, and a very considerable reversal of drainage, assisted by the outpouring of lavas, has taken place. The author pictures the rise of eastern Australia on an earth-wave that proceeded westward from the New Zealand area. The large amount of "unreduced plateau" on the crest of the wave is well seen in E. C. Andrews's model of New England (New South Wales), which is described and illustrated by him in Proc. Royal Society N.S.W., vol. xlvi., p. 143. Andrews directs attention to the agricultural possibilities of the inland slopes of Eastern Australia.

The Bulletins of the Geological Survey of Western Australia include, in No. 50, a general account of "The Geology and Mineral Industry of Western Australia," by A. G. Maitland and A. Montgomery, which is reprinted from a cyclopædia issued in Adelaide. The preparation of authoritative essays of this nature is one of the best functions of a public survey, since the ordinary citizen cannot piece together the history of his country from detailed memoirs. From the price-list given in this bulletin, which unfortunately mentions it as in preparation, we conclude that it can be obtained for about 2*s*. A geological sketch-map is included.

The West Australian goldfields are described in Bulletins 41 (West Pilbara), 42 (East Coolgardie), 45 (North Coolgardie and East Murchison), 46 (Yilgarn and North Coolgardie, southern portion), and 47 (Kanowna). The quartz-reefs that penetrate crushed and metamorphosed conglomerates in these areas are in close relation with intrusive quartz-porphyries, and E. S. Simpson and C. G. Gibson remark (No. 42, p. 64) that at Kalgoorlie sulphur and potash were introduced with gold, silver, mercury, and tellurium, through the influence of a late igneous intrusion which may or may not have reached the surface. It is pointed out that a solution of potassium sulphide dissolves both gold and tellurium. The illustrations of thin sections of the actual ore-materials are well produced and are of considerable petrographic interest. T. Blatchford and J. T. Jutson (No. 47) give a detailed account of the sheared conglomerates of Kanowna, and R. A. Farquharson discusses (p. 58) numerous types of igneous rocks, including a quartz-fuchsite-carbonate rock. This is believed to represent a former peridotite, of which chromite and fuchsite are the only unaltered relics. The type is also described in Bulletin 43, "Petrological Contributions to the Geology of Western Australia." It is clear that the official petrologist will render important service in determining the relations of the very interesting series of intrusive rocks, among which the ores have reached the surface.

Among recent publications of the Geological Survey of South Australia, general interest attaches to L. Keith Ward's Bulletin (No. 2) on the possibility of the discovery of petroleum on Kangaroo Island and Eyre's Peninsula. The author concludes (p. 25) that the asphaltum thrown up on the beaches is brought from an unknown source by oceanic currents. "Coorongite," on the other hand (p. 15), which is not proved to be in any way connected with petroleum, appears to be still accumulating from local sources as a scum on lagoons, being left behind when a shrinkage of the water takes place. Incidentally, we learn from this inquiry that Kangaroo Island is believed to have been isolated from the mainland by a system of Cainozoic fractures.

J. E. Carne describes the somewhat fitful antimony mining industry of New South Wales (Geol. Survey N.S.W., Mineral Resources, No. 16, price 2*s*.).

The Geological Survey of Queensland in Publication No. 234 deals with the Etheridge Goldfield, near Einasleigh, where barren areas of granite, composite gneiss (p. 7), and Upper Cretaceous sandstone occur along the Copperfield River. Here again, as in Western Australia, quartz-porphyry dykes appear to have some relation to the gold-bearing quartz veins; but the latter are on the whole richer in the more permeable adjacent rocks than in the porphyries themselves (p. 13). L. C. Ball (Publication 237) describes the Mount Mulligan Coalfield, about fifty miles west of the port of Cairns on the Cape York Peninsula. The Coal Measures, lying unconformably in gently sloping synclinals on uptilted grits and slates, are associated with the Glossopteris flora, and no Mesozoic plants have been found. The field is roughly estimated to contain 84,000,000 tons of somewhat friable coal.

The Geological Survey Bulletins issued by the Department of Mines in Tasmania now number thirteen, beginning with that by W. H Twelvetrees, the Government geologist, "The Mangana Goldfield," in 1907, and extending to "The Preolenna Coal Field and the Geology of the Wynyard District," by Loftus Hills, published in 1913. They are printed, like those of Western Australia, in a convenient small octavo form, with folding maps, and are in the main devoted to mining considerations. The gold ores seem to have been deposited in the veins that accompanied intrusions of granite, and these occurred at the close of an epoch of folding between Silurian and Permo-Carboniferous times. The principal folding in Tasmania is thus probably contemporaneous with the Caledonian movements of the European area. Bulletin No. 5 contains (p. 35) an interesting correlation of the Cambrian beds of Railton with those of Britain and America, and the Government geologist regards this north-western district as adding largely to our knowledge of the Older Palæozoic rocks of Tasmania. In Bulletin 8, "The Ore-bodies of the Zeehan Field," an interesting problem is raised (p. 42) by the occurrence of a glacial conglomerate dipping under "Cambro-Ordovician" beds, but probably as an inverted layer of Permo-Carboniferous age. Bulletin 9 introduces the excellent plan followed by the Survey of New Zealand, by showing on a sketch-map the position of the area described in relation to the region as a whole. W. H. Twelvetrees, in considering the more basic and hornblendic envelope of the Scamander granite (p. 19), concludes that it is a product of differentiation rather than of assimilation. The memoir on the Tasmanite shale fields of the Mersey district (No. 11, 1912) provides a valuable review of the literature on tasmanite, which is shown to be a resinous and somewhat sulphurous shale in the Permo-Carboniferous (Glossopteris) series. The seam was formed in sea-water (p. 47), and its spore-like contents may be washed-down spores of land-plants or algæ deposited with the silt. Pp. 40–54 embody a thoughtful account of the mode of occurrence and relationships of the material, and two photographs of thin sections are appended. The Mersey district, with its range of rocks from Pre-Cambrian schists to Cainozoic basalts, is made still more interesting by the maps and sections published as a supplement to the bulletin. The Preolenna Coalfield (Bulletin 13, 1913) contains Permo-Carboniferous seams amounting in the aggregate to 6 ft. 6 in., situated under the Campbell Range some fifteen miles south-west of the north coast at Wynyard. Prospecting by diamond-bores is advised. No coal is to be expected near Wynyard (p. 71).

The Geological Survey Branch of the Department of Mines of New Zealand continues its handsome series of quarto publications. Petrographers may be disappointed with Bulletin No. 12, "The Geology of the Dun Mountain Subdivision," since the exceptionally fresh olivine-rocks of Dun Mountain have made the district famous for half a century. The bibliography on pp. 6–8 perhaps explains why little more need be written on their nature and alliances. The authors, J. M. Bell, E. Clarke, and P. Marshall, describe a new rock-species, Rodingite, on p. 31. This consists of grossularite and diallage, the percentage of silica being 40, of lime 31, and the specific gravity being as high as 3·4. The authors do not see their way towards explaining this rock either by absorption of the Maitai limestone or by differentiation in the ultrabasic mass. The main object of the present bulletin has been a review of the prospects of the associated copper ores. The mineral from which the more superficial ores are derived (p. 44) is a cupriferous pyrrhotine, containing traces of gold, silver, cobalt, and nickel. This is interestingly associated with serpentinised peridotites. The chromite in the peridotites has not been mined since 1865. Dun Mountain, a rounded mass supporting little vegetation, is figured on plate iv.

Bulletin No. 13, by P. G. Morgan, who is now director of the Survey, describes the Greymouth subdivision of North Westland, where coal-seams occur, conformably overlain by marine Eocene strata. The Pleistocene glacial gravels are worked for gold, and there is said to be a probability that the Kotuku oilfield will prove profitable on further exploration. The petroleum occurs in various Cainozoic rocks above the local Coal-Measure series, and its source is at present unknown.

Bulletin 14, by E. Clarke, is also concerned mainly with petroleum, in the New Plymouth subdivision of the Taranaki division, on the jutting promontory of the west coast of the North Island. The iron-sands that compose the Recent sand-dunes and beaches are also considered, owing to their well-known richness in magnetite and ilmenite. Bulletin 15, by J. M. Bell and C. Fraser, takes us to the Hauraki division of the North Island, where the town of Waihi, picturesquely situated, and illustrated in a folding plate, is the active centre of gold and silver mining. The ore is electrum for the most part, and the veins occur in altered Cainozoic andesites or dacites resembling the propylites of Hungary. Deposition is believed to have taken place from hot solutions, which brought up silica also, and to have been promoted by a fall of temperature near the surface (p. 179). Siliceous geyser-deposits occur in the middle of the volcanic series, and cinnabar has been found in them at Mackaytown (p. 59). The physiography of the rugged country is well described, and its irregular structure is attributed to the occurrence of epochs of denudation between those of volcanic deposition (p. 27).

R. Speight, L. Cockayne, and R. M. Laing have made an interesting study of the Mount Arrowsmith district, on the eastern slope of the Southern Alps in Canterbury (Trans. New Zealand Institute, vol. xliii., p. 315), in which the physiography described by the first named author is used by his colleagues as a basis for a report on plant-distribution. The paper, with its details of glacial sculpturing and deposition, is a good example of modern geographical inquiry into the origin of surface-forms. The rivers of Canterbury are held (p. 320) to radiate from a lost highland to the west, which has been cut away by denudation, and formed the higher part of the peneplain on which they originally flowed.

G. A. J. C.

THE DEVELOPMENT AND PROPERTIES OF THE COTTON FIBRE.

THE standard accounts of the cotton fibre are curiously inaccurate. Mr. W. Scott Taggart has directed attention to some of the more glaring errors in his "Cotton Spinning" (vol. i., 1896; London: Macmillan and Co., Ltd.), as did also the present writer independently in 1905 (Khedivial Agricultural Society's Yearbook, 1905), when the cytology of the fibre was traced up to a week after the opening of the flower. Some additions to this account were outlined in my "Cotton Plant in Egypt" (London: Macmillan and Co., Ltd., 1912), and a serious attempt was then made to ascertain how and when environmental effects operated on the properties of the fibre during maturation, and also to elucidate the real nature of the infinitesimal differences which the "sixth sense" of the expert classifier of lint cotton can perceive.

(1) By pickling a complete series of bolls from flowering to maturation in 1912 we showed definitely that the first half of the maturation period is occupied in the lengthening of the lint, and in the enlargement of the capsule and seed. Thickening processes take place in the second half of the maturation period. Thus a fibre may be short, but subsequently thicken satisfactorily, or conversely. Bad weather or soil in the latter half of maturation may weaken the fibres, but cannot affect the "predetermined" length.

(2) A number of open flowers in a wide-sown pure strain were marked every day for sixty days in 1912 and allowed to ripen normally. Each sample was then combed, measured, and ginned, weighed to determine various constants, tested for breaking strain of the fibre on an automatic invention, and graded for strength; the results were examined statistically and graphically. They confirmed the developmental evidence; on shifting the breaking-strain curve backwards over thirty days' displacement, it was found to be substantially identical with the lint-length curve.

The cause of fluctuation in ginning-out-turn (ratio of lint to seed-cotton) has long been a puzzle. With this material it was traced provisionally to fluctuation in the number of lint-hairs which sprout from the seed-coat; its determination is therefore effected when the flower is about to open, which was, *a priori*, the least likely time.

Plotting breaking-strains against "strength" as determined in hand-pulling by an expert (Mr. H. C. Thomas, of Alexandria), the two were found to be completely independent; the expert unconsciously integrates breaking-strain with sectional area; samples of the same pure strain with respective breaking-strains of 12 grams and 2 grams were both graded as "SS" in a scale of seven grades. This leads on to a new definition of "fineness" in cotton fibre; it is not due primarily to differences in fibre-diameter, but to differences in the thickness of the lint cell-wall. "Weakness" of a sample is thus mainly irregularity in breaking-strain.

Determinations of fibre-weight with a micro-balance showed incidentally that an ordinary seed of Egyptian cotton bears about 10,000 fibres, and that weight is closely related to breaking-strain. The spinning into yarn introduces fresh complications, with which we have not dealt.

It should be obvious to those familiar with the subject that the discovery of this phenomenon of predetermination has shattered almost all accepted beliefs about the fibre of cotton, and has at the same time coordinated the old data afresh into a straightforward story. The practical applicability of the results is slight, since every boll passes through a different life-history, on account of the continuous fruiting of the plant.

In 1913 a series of daily pickings was made from a group of pure-strain plants growing in field-crop conditions, over a period of ninety days, with parallel records of flowering, etc. The examination of these having been delayed by unavoidable circumstances, the present note has been prepared. It should be noted that this last material is unique in the history of long-staple cotton.

These results were obtained incidentally during my tenure of the post of botanist to the Khedivial Agricultural Society, and to the Egyptian Government at the Giza Cotton Experiment Station, 1904–13.

W. LAWRENCE BALLS.

NEW ZEALAND SURVEY.[1]

THE report before us gives a full account of the work of the Department of Lands and Survey, New Zealand, for the year ending March 31, 1913. As in previous years, not only surveying, but also the direction of the magnetic observatory falls within its purview. Most of the work dealt with in the report has been undertaken in connection with cadastral requirements, and the higher grade work, which is termed "standard" survey, is in great request in town and suburban holdings, where land that could probably have been purchased sixty or seventy years ago for a mere trifle is now reported as having a value of 1200*l*. a foot. Under such conditions work of the highest precision is essential, but the new secondary triangulation is as yet available for a small part of the country only. This triangulation is the equivalent of second order triangulation, since the triangular error is kept below 6″, and is usually considerably less. This is as much as can be expected from the instrument used, a 10-in. vernier theodolite, and the Conference of Surveyors-General supported the New Zealand Survey in the opinion that a modern instrument of higher class was indispensable. A standard bar of nickel-steel 10 links long has been obtained from the Société Genevoise, Geneva, as well as a comparator from the Cambridge Instrument Company for use with it. Both of these have been examined and verified at the National Physical Laboratory. Four bases, from 5·2 to 11·5 miles in length, have been measured since 1909, but only two are as yet part of the finally accepted triangulation.

In the magnetic observatory a new set of Eschenhagen-Toepfer magnetographs were received at the end of 1912, and were installed at Amberley, thirty-four miles north of Christchurch.

Considerable assistance was given to the officers and scientific staff of the British Antarctic (*Terra Nova*) expedition, who took magnetic observations and determinations of gravity as controls to the work carried out in the Antarctic. The report also publishes ten seismograms of those recorded during the year by the Milne seismograph. Maps showing the progress of the work and extracts from Conference of the Surveyors-General of the Commonwealth of Australia, which was held at Melbourne in May, 1912, complete a report which is of much interest, and contains a record of much valuable work.

H. G. L.

[1] Report on the Survey Operations for the Year 1912–13. Department of Lands and Survey, New Zealand. By James Mackenzie, Surveyor General Pp. 77+6 maps+5 diagrams. (Wellington, 1913.)

THE ENCOURAGEMENT OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1913 of the Carnegie Institution of Washington is now available. The information provided in its 336 pages shows convincingly that there has been no relaxation of effort on the part of the trustees of the institution to administer wisely the funds placed at their disposal for the encouragement of scientific research, and that the results arrived at by the men of science who have received assistance are as promising and as full of interest as in previous years.

The following list shows the amounts of the grants made for the present year and the purposes to which they are being devoted:—

	£
Administration	10,000
Publication	12,000
Division of Publications	2,000
Departments of Research	137,929
Anthropology	4,000
Embryology	5,380
Minor Grants	18,980
Index Medicus	2,500
Insurance Fund	5,000
Reserve Fund	50,000
Exhibit at Panama-Pacific International Exposition	2,000
	£249,789

The next table shows the departments of scientific investigation to which the larger grants were made by the trustees for the financial year 1912-13, and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research	7,601
Department of Experimental Evolution	19,028
Geophysical Laboratory	15,600
Department of Historical Research	5,920
Department of Marine Biology	6,378
Department of Meridian Astrometry	5,036
Nutrition Laboratory	9,310
Division of Publications (office expenses)	1,800
Solar Observatory	33,126
Department of Terrestrial Magnetism	42,053
Researches in Anthropology	1,400
Researches in Embryology	3,000
	£150,252

The following extracts from the *résumé* of the investigations of the year included in the report of the president of the institution, Dr. R. S. Woodward, will give some indication of the work which has been initiated and encouraged:—

All the departments of research of the institution are now well-defined organisations, each of them independent of and more or less isolated from the others, and each of them devoted to a field which, while in some cases related to, does not encroach upon, the fields of others. Each of them possesses a degree of autonomy which calls for a corresponding degree of freedom in the character of their annual reports and accounts of progress.

Studies of the Salton Sea, carried on during the past seven years by the department of botanical research in collaboration with a number of contributing specialists, have been brought together during the year in a volume now in the press under the title "The Salton Sea: A Study of the Geography, the Geology, the Floristics, and the Ecology of a Desert Basin."

Among many researches carried on by the director, mention may be made of his cultivation of second and third generations of mutants arising from ovarial treatments of plants and resulting in further noteworthy morphological and physiological departures from the original parent stocks.

The work of the year in the department of experimental evolution records, among many other advances, additional contributions to the laws of human inheritance; the results of further and more conclusive studies of the transmission of traits in plants of the genera Bursa and Œnothera; and some preliminary indications of specially instructive investigations in the field of biochemistry. The director has divided his time between researches based on breeding experiments carried on at his station and studies of data bearing on human heredity collected under the auspices of the Eugenics Record Office, of which he is also the directing head.

In his annual report the director of the geophysical laboratory gives instructive accounts of the effects of pressure in the formation of minerals, of progress in the perfection of adequate appliances for calorimetric measures of minerals, of the factor of temperature in optical studies of crystals, of the results thus far obtained in volcano studies, and of the important economic investigations of the secondary enrichment of copper sulphide ores. It had been hoped that the signal success attending the studies of Kilauea a year ago might be followed up during the past year, but in this the staff has met disappointment, for the volcano has been inactive and gives no warning of renewed opportunities.

When the laboratory of the department of marine biology was established on Loggerhead Key, Dry Tortugas, Florida, now nearly ten years ago, Fort Jefferson, on an adjacent island, was an important base station of the United States Navy, and transportation to and from points on the Gulf coast was a matter of daily occurrence. In the meantime, however, this station has steadily diminished in importance, and is now virtually abandoned as a naval base. This change of conditions shifts the burden of transportation between the laboratory and the nearest port, Key West, about thirty miles distant, wholly upon the department; and the resulting increased cost and inconvenience have led the director to recommend a gradual transfer of his laboratory and activities to a more favourable site. Preliminary investigations indicate that such a site may be had in Jamaica, where health conditions and transportation facilities have been much improved in recent years, where the cost of labour and subsistence is low, and where such an international scope as best befits marine biology could be readily developed. It may be anticipated that definite plans for an advantageous change of site will be matured during the present year, and ready for submission to the board of trustees in December, 1914.

The extensive computations essential in the derivation of the great number of stellar positions observed at the temporary observatory at San Luis, Argentina, are going forward in the department of meridian astrometry at a favourable rate, so that the inclusive catalogue of precise positions for stars in both hemispheres may be expected in due time. Some instructive results of these computations, showing the stability of the San Luis meridian mark (mire), the diurnal variation of the clock corrections, and the changes of personal equation for day and night observations are given in the report. As in most lines of fruitful research, the work of this department is noteworthy for its by-products, or for contributions it is making to allied lines of inquiry. Obviously, a first requisite to a knowledge of stellar motions lies in precise determinations of stellar positions at different epochs. The so-called proper motions of stars are thus brought to light, and from these it is possible to determine also the motion of our solar system. But now comes the surprising discovery that these proper motions, hitherto supposed to be of a random character, are of a systematic nature dependent in large degree, apparently, on the stage in evolution any individual star has reached and on the group to which it belongs. A new and peculiarly fascinating field is thus opened to astronomers of all kinds, and the by-products referred to seem destined to prove not less important than its primary object in positional astronomy. The world of astronomy, however, is anxiously awaiting the attainment of this object, as is well shown by the fact that the preliminary catalogue issued by the department three years ago is already out of print.

One of the noteworthy events of the year for the department of terrestrial magnetism is the completion of the second cruise of the non-magnetic ship *Carnegie*. She arrived in New York in February last, having been continually in service since June 20, 1910. The aggregate distance traversed in her two cruises is in round numbers 100,000 miles. The corresponding distance covered by the chartered ship *Galilee*, in the Pacific Ocean during 1905–8 is 60,000 miles. Thus the total distance traversed up to date in the magnetic survey of the oceans is 160,000 miles, or about six times the circumference of the earth. Accurate magnetic data have been obtained thereby in all of the oceans between the parallels of 50° north and 50° south latitude, or near the courses usually followed by vessels. By reason of the expedition attained in deriving from these surveys the results of chief interest to mariners, it has been practicable for chart-publishing establishments to make prompt revision of defective sailing charts or to issue corrections thereto; and a distinct improvement in these aids to navigation is already noticeable in the charts issued by the leading maritime nations. In the near future it is considered that the *Carnegie* should make surveys in areas not yet covered and along some stretches already traversed where cloudy or stormy conditions have prevented the securing of adequate observations. She will at the same time cross her previous tracks as often as practicable in order to determine for such intersections the information now most needed by chart-makers, namely, the annual changes in the magnetic elements.

In the near future it is anticipated that the department will have sufficient data to permit the construction of a new set of magnetic charts, including all three magnetic elements (declination, dip, and intensity), especially for that part of the globe included between the parallels of 50° north and 50° south of the equator. It will then be practicable to study the general problem of the earth's magnetism by aid of a large mass of homogeneous data surpassing in definiteness any mass hitherto available for this purpose. In anticipation of the need of experimental facilities for studies of this problem and others closely related thereto the office and laboratory building of the department was authorised a year ago and has recently been completed.

From the date of its establishment nine years ago the solar observatory has been one of the most important of the enterprises fostered by the institution. It has called for heavy annual appropriations; it has grown with extraordinary rapidity and with equally extraordinary productivity; and it is now an organisation of which the staff of investigators, research associates and collaborators, constructors, computers, designers, mechanicians, and operators includes upwards of sixty individuals. The report of the director of the observatory has been described already (April 23, p. 201) so it need not be summarised here.

The complexity of the relations which research associates and collaborators sustain to the institution is so great as to preclude any comprehensive explanation within the limits allotted to an annual administrative report. Their work embraces a wide range of subjects, and varies in its conduct from individual independence to intimate collaboration with the departments of research and with the division of publications. During the past year more than twenty distinct fields of research have been cultivated, and a total of more than one hundred investigators have contributed to the output. Summaries of the work of associates proceeding independently are given by them in the Year Book.

THE TOTAL ECLIPSE OF 1914 IN TURKEY AND PERSIA.

ON account of the unfavourable weather prognostications for the approaching total eclipse of the sun throughout the European countries traversed by the track of totality, it seems particularly desirable that stations should be occupied beyond the Black Sea, nearer the sunset limit of eclipse, in eastern Turkey and western Persia.

The central line of the eclipse passes very nearly through Baiburt and Bitlis, just a few miles to the west of Lake Van, in the former country. In Persia it passes through Kermanshah and Khorremabad, to the south-west of Teheran, and through a point about midway between Persepolis and Dehbid, and slightly to the north-east of Shiraz, only a few miles distant from Bushire, a port in the north-east of the Persian gulf.

The desert character of a large part of this region would indicate that the probability of a cloudless afternoon sky in August is very good. Most of this region traversed by the shadow is quite elevated, some of it being as much as five or six thousand feet above sea-level; and this would, in large measure, if not entirely, compensate for the lesser altitude of the afternoon sun at local totality. Throughout the Turkish region the approximate local time of totality is 3h. 50m. p.m., the duration of total eclipse being about 120s. Throughout the Persian region the time is about 4h. 50m., with totality shortened to about 105s. As very little of the European track has a likelihood of less than 50 per cent. of cloud, it seems highly desirable that some of the observers now contemplating European location should undertake the extra journey into Turkey, at least in order to diminish, if possible, the chances of entire failure of the eclipse, such as befell astronomers in 1887, and was nearly repeated in 1896.

The region of western Persia is not especially difficult to reach by way of Batum, at the east end of the Black Sea, thence through Tiflis to Baku on the Caspian, thence to Resht on the south-west coast of the Caspian, whence Kermanshah is easy by caravan through Kazbin; or, better, first to Teheran to receive Government authority and facilities. Most of the roads of Persia would permit the use of wheeled vehicles only with difficulty. Allow four weeks from London or Paris to Teheran, and two weeks thence to Kermanshah. Camping outfit and subsistence for the most part should be taken along, as only chicken, fruits, and similar edibles can be depended on for the last stage of this journey. Roads are in part built, in part old roads and trails. From Teheran the best route is to Kum, and thence to Sultanabad and Kermanshah; also Bourodjird, quite a large town with a telegraph station, and the chief city of Luristan. Summer clouds are said to be highly improbable. From Bushire to Shiraz and Persepolis is rather more than 100 miles by caravan, the particular drawback at this season being the intense heat, which renders travel exceedingly uncomfortable, except at night. There are telegraph lines traversing this region which would make it feasible for the eclipse observer arriving early in the field to check up his longitude as well as latitude, so as to make sure of being within a few miles of the line of central eclipse. Bushire is very accessible; the steamers of the British India Company are scheduled to sail from Bombay every Thursday; from Karachi every Saturday, and are due in Bushire on Wednesday. The Bombay steamers of the P. and O. are due to arrive at Bombay on Friday, and there is direct rail connection for Karachi, and while the British India steamers are scheduled to sail from Karachi on Thursday, if the English mails are late, the steamers will be held pending their arrival. Transportation from Karachi to Bushire is approximately 15*l*.

The Turkish region is very accessible from Trebizond. The eclipse is total at Trebizond itself, the line of exact centrality intersecting the coast a few miles west of Trebizond, about midway between that port and Tereboli. While at the coast towns themselves, including Plattana, Eskiefe, and Jaueboli, the chances of clear weather are not at all good, one can, by ascending the cliffs and entering the elevated tableland of the interior, select observing stations which apparently decrease in probable cloudiness, the farther inland one goes. Of course, there are no railways; but travelling so far as Erzerum, about 150 miles south-east of Trebizond, is not particularly arduous, because it is the first section of the early caravan route through Tabriz to Teheran. Wheeled vehicles are now possible so far as Erzerum, and packages of any size and weight required by the eclipse astronomer are not prohibited.

Probably the most detailed map of this region is Richard Kiepert's "Karte von Kleinasien," on a scale of 1 : 400,000, published in 1902 by Dietrich Reimer, Berlin. The sheets which should be consulted are AVI, Tirabzon, and BVI, Erzirum. Another good map is the "Map of Eastern Turkey-in-Asia, Syria, and West Persia," published by the Royal Geographical Society, 1910, and is accompanied by notes. Consult also "Zug des Zenophon bis zum Schwarzen Meere" (Karte ii.), Entworfen von E. v. Hoffmeister, accompanying "Durch Armenien und der Zug Zenophons" (1911) and "Wandkarte des Osmanischen Reiches," von W. v. Diest and Dr. M. Groll (Gea-Verlag, Berlin W. 35, 1911); scale 1 : 1,250,000.

Erzerum itself is within the belt of totality, though not far from the north-eastern edge of it, so that totality would not last more than a very few seconds there. Besides this, Erzerum is quite likely to be cloudy; and the same might be said of Bitlis itself, which is located in a sheltered valley. But about fifteen miles west of Bitlis begins the elevated tableland of Moush, which, according to the best information I have been able to secure from those resident in Bitlis, would probably be cloudless. At the time of the eclipse, this whole region rarely experiences any rain from the latter part of June until the middle of September. The atmosphere is very clear, being only a trifle cloudy during that season, and clear skies can be depended upon, although it is extremely hot.

Officers of the Turkish customs are not inclined to cause trouble over the baggage of travellers, and it is probable that the English and American Consuls would be able to get instruments passed without examination, especially if the observer brought a letter visèd by the Turkish Consul nearest his home.

It would be highly desirable, before leaving home, to pack all parcels of instruments with especial reference to caravan travel, as otherwise repacking in Trebizond would be necessary and much delay occasioned. Two hundred pounds is too heavy, and it is better if no package exceed 150 lb., as a mule must carry two of them; the average load is about 300 lb. As a mule must have a perfectly balanced load, it is well to have the paraphernalia so divided that pairs of packages will be of the same weight. The nearer a parcel approaches a cube, the easier it is to handle, though moderately oblong packages are not particularly troublesome. Packing must, of course, be done much more thoroughly than for transit by railway and steamship, as the continued motion of a pack animal will cause screws and delicate parts of instruments to disconnect themselves. I have found nothing better for packing than granulated cork, such as Malaga grapes are packed in.

As before said, travel so far as Erzerum can be accomplished in fairly comfortable carriages, and even a rubber-tyred vehicle is possible. Baggage might go in a species of lumber wagon, or springless vehicle; but beyond Erzerum carriages would not go, except at great expense. From Trebizond to Erzerum eight days of travel should be allowed, by starting promptly every morning. From Erzerum to Bitlis would require eight or nine days; and before leaving either Trebizond or Erzerum, it is necessary to make the drivers or muleteers agree to arrive at the desired place on a certain day; then, in addition to this, the traveller must keep prodding them to see that they make their schedule. They much prefer to travel in the very early morning, starting from three to five o'clock. The journey from Erzerum to Bitlis cannot be called an easy one; but the country and its people are very interesting.

The eastern end of the plain of Moush is a day's journey from Bitlis on the route to Erzerum, and on this plain at this time of year the American residents of Bitlis usually spend two or three quiet and healthful months in camp.

To the west of Bitlis and far outside the path of totality, although in the same generally elevated region of Turkey, is Kharput, where records of cloudiness for the month of August have been kept for many years past. The average for five years gives 70 per cent. of the afternoon observations in August entirely cloudless, with not a single record of a sky totally overcast. Most of the cloudiness is of the order of 0·1 or 0·2, only occasionally an afternoon being largely overcast. These afternoon observations were taken at 2.30, and there is a slightly greater chance of cloudiness at 4.

For most of the foregoing information I am indebted to the Rev. Dr. Henry H. Riggs, of Kharput, Dr. Harrison A. Maynard, of Bitlis, Rev. Robert A. Stapleton and Dr. Edward P. Case, of Erzerum, and Rev. L. S. Crawford, of Trebizond. All are greatly interested in the coming eclipse, and are ready to assist in observing it so far as possible.

Prof. A. G. Sivaslian, of Anatolia College, Marsovan, will proceed eastward to the Trebizond region to observe the eclipse. He is an astronomer trained at the Northfield Observatory in Minnesota, and will be of great assistance to whatever party of observers he may join; also Prof. A. H. Joy, of the Syrian Protestant College at Beirut, is expecting to join the ranks of the eclipse observers, but he may go to the Crimea instead of Trebizond.

Of course, it is well known that Trebizond is very accessible. The easiest route from western Europe is *viâ* Marseilles, whence a weekly steamer of the Messagerie leaves for Trebizond without change at Constantinople or elsewhere. The same from Trieste also, by the Austrian Lloyd. From Paris the through rate by rail to Marseilles, and thence by steamer to Trebizond is about 14*l.* first class. From Constantinople steamers leave every Friday and Saturday, reaching Trebizond the following Tuesday and Wednesday mornings.

Fuller information regarding the Persian region can be obtained from the house of Messrs. Lynch Brothers in London, and concerning Armenia the standard work is by the late senior member of this firm, Mr. H. F. B. Lynch, recently published in two fine volumes by Longmans. DAVID TODD.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The completion of the third edition of "The Golden Bough" has suggested to the many friends and admirers of Dr. J. G. Frazer that the present is a suitable time to offer him some token in recognition of his great services to learning. It is proposed that a Frazer Fund for Social Anthropology be established to make grants to travelling students of either sex, whether connected with a university or not, with a view of their investigating problems in the culture and social organisation of primitive peoples, a department of anthropology which Dr. Frazer has always been eager to promote. Contributions to the fund may be sent either direct to the secretary and treasurer, Mr. F. M. Cornford, Trinity College, Cambridge, or to the "Frazer Fund Account," Messrs. Barclay and Co., Mortlock's Bank, Cambridge.

LONDON.—Presentation Day on May 13 passed off without special incident. The Principal reported a slight falling off of examinees, particularly for matriculation. Of the 1807 candidates for degrees 900 were internal and 907 external; 1301 degrees and diplomas were granted, and the total number of internal students is now 4888. Sir Philip Magnus, M.P. for the University, in his speech after the presentation of graduates, suggested that a committee of the Senate should be appointed to consider without prejudice or bias the recommendations of the Royal Commission on University Education in London with the view of deciding which of them should be adopted with or without legislation.

MR. ALFRED E. CAMERON, Board of Agriculture scholar in entomology, of Manchester University, has taken up economic work in the United States, where he is temporarily attached to the entomological department of the New Jersey Agricultural Experiment Stations, New Brunswick, New Jersey.

MR. MALCOLM E. MACGREGOR, of Trinity College, Cambridge, has recently been appointed collaborator with the U.S. Bureau of Entomology, to join the Robert M. Thompson Pellagra Commission (formerly the Thompson-Macfadden Pellagra Commission), at Spartenburg, South Carolina, to study the possible rôle played by insects in the transmission of the disease.

WE learn from the Paris correspondent of the *Chemist and Druggist* that the council of the University of Paris has just decided to distribute 3600*l.*, being interest of a bequest by the late M. Loutreuil for the encouragement of scientific laboratories of French universities. The Chemical Institute of Nancy University is receiving 400*l.* for extension and enlargement, and Toulouse 800*l.* for the foundation of a similar establishment. Montpellier University will get 160*l.* for its biological laboratory, Rennes 320*l.* for the botanical and physical science laboratories, Lille, Clermont, and Grenoble are getting goodly sums for electrical equipment, and Paris 100*l.* for the herbarium of the Academy of Sciences.

THE Association of Teachers in Technical Institutions will hold its eighth annual conference at Liverpool during Whitsuntide, May 30–June 3. The open meetings begin on Monday, June 1, when the chairman of the Liverpool Education Committee, Councillor J. W. Alsop, will welcome the conference to Liverpool, and the president, Mr. P. Abbott, will deliver his presidential address. During the conference papers will be read by Mr. W. Hewitt, director of technical education for Liverpool, Prof. Haldane Gee, Mr. W. E. Harrison, Mr. Laurence Small, Mr. W. R. Bower, and others. Sectional meetings will be held on the afternoon of June 2, when papers of special interest to the various sections of technical education will be read. Resolutions on matters of educational and professional interest will be discussed at the various meetings.

A LIMITED number of free places at the Imperial College of Science and Technology, South Kensington, S.W., will be awarded by the London County Council for the session 1914–15. The free places will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study which they intend to follow, and generally upon their fitness for advanced study in science as applied to industry. Candidates will not be required to undergo a written examination. It is possible that the free places may be extended to two or more years. Parents (or guardians) of candidates must be resident within the administrative county of London, except in the case of self-supporting candidates above twenty-one years of age on July 31, 1914, who must themselves be resident within the county. Application forms (T. 2/268) may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, W.C., and must be returned not later than Saturday, May 23.

IN addition to much other matter of interest and importance, the recently published Report of the Board of Education for the year 1912–13 (Cd. 7341), contains particulars as to the main provision for full-time education in connection with the industries of the country. This has been provided in the past either by means of advanced courses known as technical institution courses at the larger technical schools, or by means of day technical classes, which, as a rule, take younger pupils and give more elementary instruction. There are twenty-six institutions giving technical institution courses, the total number of separate courses in these institutions being eighty-one in 1911–12. But of these twenty-two were courses in preparation for matriculation. Fifty-four were courses in engineering, chemistry, and subjects connected with the building, mining, textile, and leather trades. Five were purely scientific courses. The number of students taking full courses was 1246, of whom 528 were in their first year, 414 in their second year, 245 in their third year, and fifty-nine in later years of their courses. The number of day technical classes recognised in 1911–12 was in all 324, and these were held in 111 institutions. The students in attendance numbered 12,041. One hundred and fifty-four of the courses were full-time day schools, and these will in future receive aid from the State to a degree more commensurate with their importance. The report may well point out that the provision for full-time education in applied science is regrettably small in bulk compared with the industrial development of the country.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 14.—Sir William Crookes, president, in the chair.—Dr. A. D. **Waller**: The various inclinations of the electrical axis of the human heart. Part IA.—The normal heart.—Effects of respiration. Continuation of previous observations (Phil. Trans., 1889, p. 169) in which the electrical effects of the human heart were first demonstrated, and the distinction made between favourable and unfavourable leads dependent upon the obliquity of the cardiac axis, and of subsequent observations (Proc. R.S., B, vol. lxxxvi., p. 507, 1913) to determine the angular value of the inclination of the electrical axis.—Dr. D. H. **Scott** and Prof. E. C. **Jeffrey**: Fossil plants showing structure from the base of the Waverley Shale of Kentucky. The specimens were collected by Prof. C. R. Eastman and Mr. Moritz Fischer, near Junction City, Boyle County, Kentucky. The nodule layer containing the plants is described by Prof. Eastman as lying at the base of the Waverley (Lower Carboniferous) and immediately above the Genessee Black Shale of Upper Devonian age. The anatomical structure is, on the whole, well preserved.—F. **Kidd**: The controlling influence of carbon dioxide in the maturation, dormancy, and germination of seeds. Part ii. The inhibitory effect of carbon dioxide on the germination of seeds previously described is dealt with in relation to temperature and oxygen supply. In relation to temperature the result obtained is unusual, the inhibitory action being more pronounced at low temperatures than at high. At 3° C. complete inhibition was obtained with 4 per cent. CO_2; at 17° C. as much as 24° C. had to be employed to obtain the same result. Varying partial pressures of oxygen also effect the inhibitory action of carbon dioxide, but to a less degree than temperature. Thus with 5 per cent. oxygen, 15 per cent. CO_2 produced inhibition; with 20 per cent. oxygen, 27 per cent. CO_2 was necessary. The author emphasises the fact that the adjustments of the moist seed by which it is enabled to continue dormant in the presence of oxygen and water, rather than those of the dry seed, are likely to have formed the central problem of seed life in nature. A low temperature and a decreased oxygen supply are often the natural conditions of a seed's environment in the soil. Correlating the results obtained in this and in a former paper, the author strongly emphasises the controlling influence of carbon dioxide in the biology of seeds. It appears that the normal resting stage of a seed is primarily a phase of narcosis.—D. **Thomson** and J. G. **Thomson**: The cultivation of human tumour tissue *in vitro*. Small portions of tissue from two human tumours, (*a*) intracystic papilloma of the ovary, and (*b*) carcinomatous lymphatic gland, have been cultivated successfully in a medium composed of fowl blood plasma + extract of embryonic chick. This proves that human tissue can be grown *in vitro* in a medium obtained entirely from a bird. This is contrary to what was previously believed, since it was considered that the tissue of a certain animal could only grow in a medium composed of the blood plasma of the same species of animal.—H. G. **Thornton** and G. **Smith**: The nutritive conditions determining the growth of certain fresh-water and soil protista. Experiments made on the growth of *Euglena viridis* in artificial media showed that, in addition to those inorganic constituents necessary for the growth of a green plant, which were supplied by Miguel's formula for growing diatoms, a certain quantity of organic material, *e.g.* infusion of hay, was necessary. In order to determine the constituent in this organic material which stimulated growth, various pure substances, such as carbohydrates, tartaric acid, saccharin, allantoin, peptone, and various amido-acids, were used in dilute solutions. Of these, only very weak solutions of amido-acids favoured a really strong growth, the most favourable substances being tyrosin and phenyl-alanine, which are very slightly soluble in water. Experiments with soil flagellates, especially *Prowazekia terricola* (Martin), showed that they could be cultivated in many solutions in which bacteria flourished, the flagellates feeding on several different kinds of bacteria. Samples of various types of soil and water were tested for the presence of bacterial-feeding flagellates, and these were found in all the samples, being most abundant in highly manured soil. The wide distribution and abundance of these soil flagellates, and their very rapid growth in the presence of bacteria, suggests that they are of importance in the economy of the soil.

Zoological Society, May 5.—Dr. Henry Woodward, vice-president, in the chair.—Surgeon G. Murray **Levick**: Manners and customs of Adélie penguins (*Pygoscelis adeliae*). The penguins were observed at the Cape Adare rookery while the author was with Scott's Antarctic Expedition. Their mating habits, the making of their "nests," hatching of the eggs, and rearing of the young were described.—R. C. **Lewis**: Two new species of tapeworms from the stomach and small intestine of a wallaby from Hermite Island, Monte Bello Islands. The parasites belong to the genus Cittotænia, having two full sets of genital glands in each proglottis.—Oldfield **Thomas**: A remarkable case of affinity between animals inhabiting Guiana, West Africa, and the Malay Archipelago. The case referred to was that of the pygmy squirrels (Nannosciurinæ), known to the natives of West Africa and the Malay Archipelago, and of which Mr. Thomas was now able to state that the Guianan *Sciurus pusillus* was also a member. It was sufficiently distinct to need generic separation (Sciurillus, gen. nov., was suggested as a name for it), but was unquestionably assignable to the Nannosciurinæ, and not to the Sciurinæ, to which all the other American, all the European, and all the Asiatic continental squirrels belonged.—H. B. **Preston**: Diagnoses of new general and species of Zonitidæ from equatorial Africa. The material on which the paper is based was recently collected from many localities in British East Africa, Uganda, and the Belgian Congo, by Messrs. A. Blayney Percival, Robin Kemp, and C. W. Woodhouse, and descriptions are given of seventy-six new species, two new varieties, and eight new genera of Zonitidæ, to which latter a number of hitherto described forms are also referred.

Mathematical Society, May 14.—Prof. A. E. H. Love, president, in the chair.—Prof. W. H. **Young** and Mrs. **Young**: The reduction of sets of intervals.—Prof. H. M. **Macdonald**: Diffraction by a straight edge.—J. **Proudman**: Diffraction of tidal waves on flat rotating sheets of water.—H. F. **Moulton**: Quadratic forms and factorisation of numbers.—F. S. **Macaulay**: The algebraic theory of modular systems.

MANCHESTER.

Literary and Philosophical, May 12.—Mr. F. Nicholson, president, in the chair.—F. R. **Lankshear**: The chemical significance of absorption spectra and a new quantitative method of measuring them. The author reviewed the history of the study of the relation between chemical constitution and absorption spectra, and the various theories as to the cause of absorption bands. He pointed out that for further progress to be achieved quantitative methods were necessary.—Dr. J. R. **Ashworth**: Note on the intrinsic field of a magnet. An experiment on the electromotive force between magnetised and unmagnetised iron in a solution, from which an argument was drawn in favour of the view that in the interior of a magnet there is an enormously strong field acting on the molecular magnets.

DUBLIN.

Royal Irish Academy, May 11.—Rev. J. P. Mahaffy, president, in the chair.—J. G. **Leathem**: Doublet distributions in potential theory. The paper discusses the formulation of the problem of irrotational liquid motion as a double-sheet problem. In connection with the hydrodynamical application it examines some aspects of doublets and doublet distributions, and the manner in which these and their fields fit into Kelvin's theory of inversion. A surface concentration of tangential doublets is also considered, and an account is given of the convergence or semi-convergence of the potential and force integrals associated with it. J. R. D. **Holtby**: Some human bones from an ancient burial ground in Dublin. The paper dealt with a collection of human bones discovered about a year ago buried deeply under the basement of the City Hall These were considered to represent inhabitants of Dublin about the twelfth to fourteenth centuries. Apart from the worn condition of the teeth, found in almost all ancient remains, the chief interest lay in the form of the bones of the lower limbs and in the impressions on them. These were such as to suggest full and frequent flexion at the hip, knee and ankle joints, such as would occur in squatting

PARIS.

Academy of Sciences, May 11.—M. P. Appell in the chair.—Ch. **Lallemand**: The question of the litre. For scientific purposes the author considers the definition of the litre as the volume of a kilogram of water at 4° C., and 76 cm. pressure should remain. The correction to a cubic decimetre is +27 millionths (0·027 gram).—Mme. **Ramart-Lucas** and A. **Haller**: Syntheses by means of sodium amide. The action of the epihalohydrins on the dialkylacetophenones. Oxypropylene-dimethylacetophenone and its derivatives. The dialkylacetophenones treated with sodium amide and epihalohydrins give substitution products in which the halogen is replaced in a normal manner, whilst with acetophenone itself only tarry reaction products are obtained.—E. **Jungfleisch** and Ph. **Landrieu**: Researches on the acid salts of the dibasic acids. Oxalates. From the experiments detailed the conclusion is drawn that acid potassium oxalate should be represented as $(K_2C_2O_4.H_2C_2O_4)$ and not as $KH.C_2O_4$. The results are analogous with those previously obtained for the acid camphorates.—Charles **Richet**: General anaphylaxy. Phosphorus poisoning and chloroform. It has been shown in a preceding note that a dog chloroformed for the first time never subsequently shows leucocytosis, but that a month later the same dog, although in perfect health, if submitted a second time to chloroform, always subsequently shows leucocytosis. It is now shown that an animal, after treatment with non-toxic doses of a phosphide, and then a month later submitted to chloroform, presents the same phenomenon. This entails a modification of the generally accepted view of the specific nature of anaphylaxy.—A. **Calmette** and V. **Grysez**: A new experimental demonstration of the existence of a generalised lymphatic stage preceding localisations in tuberculous infection It is shown that whether the tubercle bacilli enter by the eye, throat, alimentary canal, skin, or lungs, before local lesions appear, the bacilli can be proved to be present in the tracheo-bronchial, submaxillary, and mesenteric ganglia, in the spleen and blood.—H. **Parenty**: A regulator for the flow of water in streams and reservoirs with constant level. J. W. **Nicholson**: The atomic weights of the elements of nebulæ. A discussion of the results recently published by MM. Bourget, Fabry, and Buisson on the spectra of nebulæ. —A. **Buhl**: The geodesic torsion of closed contours.—N. E. **Nörlund**: Series of faculties and the methods of summation of Cesarò and Borel.—Léopold **Fejér**: The number of changes of sign of a function in an interval and its moments.—Léon **Brillouin**: The diffusion of light by a homogeneous transparent body.—André **Léauté**: The mathematical theory of the working of electric lines formed of two different trunks.—J. de **Kowalski**: The oscillating spark as an economical source of ultra-violet light.—Alexandre **Dufour**: A kathodic oscillograph.—René **Constantin**: Fluctuations of concentration in a colloidal emulsion.—André **Helbronner** and Gustave **Bernstein**: The vulcanisation of solutions of india-rubber by ultra-violet light.—Œchsner de **Coninck** and M. **Gérard**: The determination of the atomic weight of nickel. The figure 58·57 was obtained as a mean of five determinations of the amount of nickel obtained by the reduction of the hydrated oxalate in hydrogen at 270° C.—M. **Picon**: The preparation of normal pentene. Remarks on the melting and boiling points of the first terms of the true normal acetylene hydrocarbons. This hydrocarbon has been prepared by the interaction of normal propyl iodide and an ammoniacal solution of monosodium acetylene at −20° C. Its physical constants are given.—Georges **Dupont**: The synthesis of the acetylene γ-diketones. Good yields are obtained by the oxidation of the acetylene γ-glycols by chromic acid in acetic solution. Three examples of the reaction are given.—Andre **Brochet**: The catalytic hydrogenation of liquids under the influence of the common metals at moderate temperatures and pressures.—Charles **Tanret**: The plurality of the starches.—R. **Souèges**: New observations on the embryogeny of the Crucifereæ.—Paul de **Beauchamp**: The evolution and affinities of the genus Dermocystidium.—MM. **Variot** and **Fliniaux**: Tables of the comparative growth of infants raised at the breast or by the bottle during the first year of life. Contrary to current ideas, there is a very small difference between the size and weight of children raised at the breast or by the bottle, if the food in the latter case is properly made up.—Louis **Roule**: The influence exercised on the migration of salmon (*Salmo salar*) by the proportion of dissolved oxygen in the streams. On the coast of Brittany it has been noticed that the salmon select certain rivers in preference to others and for no obvious reason. Determinations of the proportions of dissolved oxygen in the river waters shows that the salmon select those in which this proportion is highest.—Rémy **Perrier** and Henri **Fisher**: The existence of spermatophores in some Opisthobranchs.—Ch. **Gravier**: The Madrepores collected by the second French Antarctic Expedition (1908–10).—A. **Malaquin** and A. **Moitié**: Experimental observations and researches on the evolutive cycle of *Aphis euonymi*, destructive to the beetroot.—R. **Fosse**: The simultaneous presence of urea and urease in the same plant.—Em. **Bourquelot** and Alex. **Ludwig**: The biochemical synthesis of β-anisylglucoside.—L. **Lematte**: The estimation of the monoamino-acids in the blood. The albumenoids and ammonia are precipitated by phosphotungstic acid, neutralised with soda and the excess of the phosphotungstic acid precipitated by calcium chloride, and excess of the latter by oxalate. The solution then contains the amino-acids, and can be determined by the formol method.—Louis **Mengaud**: The tectonic of the neighbourhood of Infiesto, Arriondas and Rivadesella (Asturia).—M. **Dalloni**: The Neocomian in the west of Algeria.

BOOKS RECEIVED.

Plague and Pestilence in Literature and Art. By Dr. R. Crawfurd. Pp. viii + 222 + 31 Plates. (Oxford: Clarendon Press.) 12*s.* 6*d.* net.

Ministerio de Fomento. Boletin del Cuerpo de Ingenieros de Minas del Peru. No. 8c. Estadistica Mineraen, 1912. By C. P. Jimenez. Pp. 125. (Lima.)

Report of the Agricultural Research Institute and College, Pusa, 1912–13. Pp. 3 + 119. (Calcutta.) 8*d.*

The Forty-Second Annual Report of the Board of Directors of the Zoological Society of Philadelphia. Pp. 51. (Philadelphia.)

Sammlung Vieweg. Heft 1, Die Lichtelektrischen Erscheinungen. By Drs. R. Pohl and R. Pringsheim. Pp. v + 114. Heft 4, Die Lichtbrechung in Gasen als Physikalisches und Chemisches Problem. By Dr. St. Loria. Pp. vi + 92. Heft 5, Die Radioaktivität von Boden und Quellen. By Prof. A. Gockel. Pp. v + 108. (Braunschweig: F. Vieweg und Sohn.) Each 3 marks.

Sammlung naturwissenschaftlicher Praktika. Band iv. By Prof. O. Emmerling. Pp. vii + 200. (Berlin: Gebrüder Borntraeger.) 7.20 marks.

Lehrbuch der Anthropologie in systematischer Darstellung. By Prof. R. Martin. Pp. xvi × 1181 + Taf. iii. (Jena: G. Fischer.) 35 marks.

The West India Committee Map of the West Indies. (London: G. Philip and Son, Ltd.) Mounted, 10*s.* 6*d.*

The University of Colorado Studies. Vol. xi. No. 1, Fishes of Colorado. By Dr. M. M. Ellis. Pp. 136 + xii plates. (Boulder, Colorado.) 50 cents.

The Modern Method of Photographing Furniture. Pp. 16. (London: Kodak, Ltd.) 3*d.*

Union of South Africa. Province of the Cape of Good Hope. Marine Biological Report, No. 1, for the Year Ended December 31, 1912, and for the Half-Year ending June 30, 1913. Pp. iii + 70 + ii + plates iii. (Cape Town: *Cape Times*, Ltd.)

Canada. Department of Mines. Mines Branch. Researches on Cobalt and Cobalt Alloys, conducted at Queen's University, Kingston, Ontario, for the Mines Branch of the Department of Mines. Part i. Preparation of Metallic Cobalt by Reduction of the Oxide. By Dr. H. T. Kalmus and others. Pp. x + 36 + plates viii. (Ottawa.)

Beiträge zur Geschichte der Meteorologie. By G. Hellmann. Nr. 1–5. Pp. 147. (Berlin: Behrend and Co.) 5 marks.

Constructive Text-Book of Practical Mathematics. By H. W. Marsh. Vol. iv., Technical Trigonometry. Pp x. + 232. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* 6*d.* net.

The Theory of Numbers. By Prof. R. D. Carmichael. Pp. 94. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s.* 6*d.* net.

The Wilds of Maoriland. By Dr. J. M. Bell. Pp. xiii + 253 + plates. (London: Macmillan and Co., Ltd.) 15*s.*

The Schools and the Nation. By Dr. G. Kerschensteiner. Translated by C. K. Ogden. Pp. xxiv + 351 + plates. (London: Macmillan and Co., Ltd.) 6*s.* net.

Hereditary Genius. By F. Galton. Reprint. Pp. xxviii + 379. (London: Macmillan and Co., Ltd.)

The Quaternary Ice Age. By W. B. Wright. Pp. xxiv + 464 + xxiii plates. (London: Macmillan and Co., Ltd.) 17*s.* net.

Marine Engineering. By Engineer-Captain A. E. Tompkins. Fourth edition. Pp. viii + 812. (London: Macmillan and Co., Ltd.) 15*s.* net.

The Childhood of the World. By E. Clodd. New edition. Pp. xiii + 240. (London: Macmillan and Co., Ltd.) 4*s.* 6*d.* net.

Canada. Department of Mines. Geological Survey. Memoir 25. Report on the Clay and Shale Deposits of the Western Provinces. (Part ii.) By H. Ries and J. Keele. Pp. 105. Memoir 44, No. 37, Geological Series. Clay and Shale Deposits of New Brunswick. By J. Keele. Pp. viii+94+xvi plates. Memoir 48, No. 2, Anthropological Series. Some Myths and Tales of the Ojibwa of South-eastern Ontario. Collected by P. Radin. Pp. v+83. Museum of the Geological Survey, Canada. Archæology. The Archæological Collection from the Southern Interior of British Columbia. By H. I. Smith. Pp. ii+40+xvi plates. (Ottawa: Government Printing Bureau.)

Theory of the Atom. By Prof. T. Mizuno. (In Japanese.) Pp. 3+285+6. (Tokyo: Maruzen Co., Ltd.)

Researches into Induced Cell Reproduction in Amœbæ. By J. W. Cropper and A. H. Drew. (The John Howard McFadden Researches, vol. iv.) Pp. 112. (London: J. Murray.) 5*s*.

A Path to Freedom in the School. By N. MacMunn. Pp. 162. (London: G. Bell and Sons, Ltd.) 2*s*. net.

The History and Economics of Indian Famines. By A. Loveday. Pp. xi+163. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*. net.

Effetti dei Fulmini Globulari. By Prof. I. Galli. Pp. 70. (Roma: Tipografia Pontificia.)

The World Set Free. By H. G. Wells. Pp. vi+286. (London: Macmillan and Co., Ltd.) 6*s*.

How to Understand Aeroplanes. By S. L. Walkden. Pp. xiii+99. (London: P. Marshall and Co.) 1*s*. net.

The Horticultural Note Book. Compiled by J. C. Newsham. Third edition. Pp. xx+418. (London: Crosby Lockwood and Son.) 4*s*. 6*d*. net.

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbeltiere. Edited by Prof. A. Oppel. vii. Teil. Pp. x+417. (Jena: G. Fischer.) 18 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 42 Lief. Band iii. Hälfte 1. Pp. 1447–1598. (Jena: G. Fischer.) 5 marks.

DIARY OF SOCIETIES.

THURSDAY, MAY 21.

ROYAL SOCIETY, at 4.30.—The Effect of the Magneton in the Scattering of α Rays: Prof. W. M. Hicks.—Luminous Vapours Distilled from the Arc, with Applications to the Study of Spectrum Series and their Origin. I.: Hon. R. J. Strutt.—The Ionisation of Gases by Collision and the Ionising Potential for Positive Ions and Negative Corpuscles: W. T. Pawlow.—The Determination of Elastic Limits under Alternating Stress Conditions: C. E. Stromeyer.—The Emission of Electricity from Various Substances at High Temperatures: G. W. C. Kaye and W. F. Higgins.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Gulf Stream: Commander Campbell Hepworth.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Leaching of Oxidized Copper Ores by Modified Dorr Classifiers at the Butte-Duluth Mine: C. S. Herzig.—(1) A Graphic Method for Recording Grading Analyses; (2) The Application of Kick's Law to the Measurement of Energy Consumed in Crushing: S. J. Speak.—Notes on Mine Contract Work in Mexico and the Argentine Republic: A. Livingstone Oke.—The Ore Veins of the Fundkofel Gold Mine near Oberdrauburg in Carinthia: F. W. Penney.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Census of 1911: Ethnography and Occupations: E. A. Gait.

ILLUMINATING ENGINEERING SOCIETY, at 8.—The Nomenclature and Definitions of Photometric Quantities: A. P. Trotter.

FRIDAY, MAY 22.

ROYAL INSTITUTION, at 9.—The Mortuary Chapels of the Theban Nobles: R. Mond.

PHYSICAL SOCIETY, at 5.—Volatility of Thorium Active Deposit: T. Barratt and A. B. Wood. The Passage of α-Particles through Photographic Films: H. P. Walmsley and Dr. W. Makower.—A Null Method of Testing Vibration Galvanometers: S. Butterworth.—Experiments with an Incandescent Lamp: C. W. S. Crawley and S. W. J. Smith.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Neglected Steam Car: R. S. Box.

SATURDAY, MAY 23.

ROYAL INSTITUTION, at 3.—Fiords and their Origin. I.: The Nature and Distribution of Fiords: Prof. J. W. Gregory.

MONDAY, MAY 25.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Development of British East Africa and Uganda: Major E. H. M. Leggett.

CHEMICAL SOCIETY, at 6.—Faraday Lecture: Electrolytic Dissociation: Prof. Svante Arrhenius.

TUESDAY, MAY 26.

ROYAL INSTITUTION, at 3.—Natural History in the Classics. II.: The Natural History of Aristotle and of Pliny: Prof. D'Arcy W. Thompson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Ravhas of Assam: J. E. Friend-Pereira.

ROYAL SOCIETY OF ARTS, at 4.30.—The Singing of Songs: Old and New. III.: Modern Songs: H. Plunkett Green.

WEDNESDAY, MAY 27.

GEOLOGICAL SOCIETY, at 8.—The Development of *Tragophylloceras loscombi* (Sow.): L. F. Spath.—The Sequence of Lavas at the North Head, Otago Harbour, Dunedin (New Zealand): Prof. P. Marshall.

ROYAL SOCIETY OF ARTS, at 8.

THURSDAY, MAY 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Studies of the Processes Operative in Solutions. XXIX.: The Disturbance of the Equilibrium in Solutions by "Strong" and "Weak" Interfering Agents: Prof. H. E. Armstrong and E. E. Walker.—A Type-reading Optophone: Dr. E. E. Fournier d'Albe.—An Application of Electrolytically-produced Luminosity forming a Step towards Telectroscopy: L. H. Walter.—The Convection of Heat from Small Cylinders in a Stream of Fluid and the Determination of the Convection Constants of Small Platinum Wires, with Applications to Hot-wire Anemometry: L. V. King.

ROYAL INSTITUTION, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

FRIDAY, MAY 29.

ROYAL INSTITUTION, at 3.—Plant Autographs and their Revelations: Prof. J. C. Bose.

SATURDAY, MAY 30.

ROYAL INSTITUTION, at 3.—Fiords and their Origin. II.: Fiords and Earth Movements: Prof. J. W. Gregory.

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THURSDAY, MAY 28, 1914.

GREEK PHYSICS AND DYNAMICS.

Le Système du Monde: Histoire des Doctrines Cosmologiques de Platon à Copernic. By Prof. Pierre Duhem. Tome Premier. Pp. 512. (Paris: A. Hermann et Fils, 1913.) Price 18.50 francs.

THIS book contains a good deal more than one might expect from the title. It not only gives an account of the cosmical systems of the Greeks from Pythagoras to Ptolemy, but discusses in considerable detail the views of the different schools of the same period as to the constitution of matter, and their principles of dynamics. As was to be expected from the author's previous publications on the history of natural philosophy, he shows himself well acquainted with ancient literature, and also (with a few exceptions) with the very extensive modern literature of monographs on Greek science. The most recent editions of the classical writers are always quoted, but with one notable exception, Diels's edition of the Doxographi Græci not having been made use of.

The astronomical chapters, which fill less than half the book, do not call for any extended notice, as the subject treated in them has been dealt with in more than one book accessible to English readers, the last being Sir Thomas Heath's book on Aristarchus, published only a year ago. As to the origin of the heliocentric idea, the author follows in the main the theory of Schiaparelli, that it was really due to Herakleides, fifty years before the time of Aristarchus, and he seems unconvinced by the weighty arguments brought forward against it by subsequent writers.

The most valuable part of M. Duhem's book is undoubtedly that dealing with the physics and dynamics of the Greeks, especially of Aristotle, and it gives a very clear and thorough account of this difficult subject. While Plato's views on nature were characterised by doubts as to facts learned by perception, as the immutability which is regarded as the essence of things is not revealed thereby, Aristotle rehabilitated experience and observation, though often led astray by preconceived notions. In his dynamics the idea of mass does not enter; every moving body is necessarily subject to two forces, a power and a resistance; without a power it would not move at all, without resistance the motion would be accomplished in an instant. The velocity with which the body moves depends both on the magnitude of the power and on that of the resistance; if both are constant the resulting motion is supposed to be uniform; if the resistance decreases the velocity will increase, if the same power be employed to move resisting bodies, the velocities which it communicates to them are inversely proportional to the resisting weights.

Velocity is therefore proportional to the ratio of power to resistance, and yet, how can motion cease when they become equal? Aristotle sees this difficulty and tries to get over it by remarking that because a certain power moves a body through a certain length it does not follow that any fraction of the power will move the body through the same fraction of the length. A body falling through air or water represents to Aristotle the simplest motion we can conceive; the power is here the weight of the body, while the resistance is caused by the medium it traverses, and the velocity of the fall is proportional to the weight. On the other hand, by the fundamental principle of Aristotelian dynamics, the velocity is inversely proportional to the resistance, and Aristotle seems to admit that this resistance is proportional to the density of the medium. But he maintained that if a fall in empty space were possible (which he denies), bodies of different weight would not fall with the same velocity. "This," he says ("Physics." iv. 8, p. 216a), "is impossible, for what should then cause one body to move faster? This is necessarily the case in a medium because the body which has the greater power divides the medium more quickly, but in the void all bodies would have the same velocity, which is impossible."

The author also discusses very fully the theories prevalent after Aristotle so far as John Philoponus in the sixth century. In opposition to Aristotle, Philoponus taught that weight is something which belongs to a body and represents the downward motion it would have in empty space; the resisting medium prolongs the time of the fall, but if the resistance is diminished to zero the fall does not become instantaneous, the limit of the velocity being that with which it would fall through empty space. This doctrine, so different from that of Aristotle, was not accepted in the Middle Ages, though it was not without some influence on the views of Simplicius, who otherwise was a severe critic of Philoponus. We shall look forward with interest to M. Duhem's second volume, in which he will doubtless discuss the views of Thomas Aquinas and other philosophers of the Middle Ages, which did not always coincide completely with those of Aristotle.

J. L. E. D.

A MODIFIED ALPHABET FOR ENGLISH.

Sounds and Signs: a Criticism of the Alphabet with Suggestions for Reform. By Archer Wilde. Pp. 180. (London: Constable and Co., Ltd., 1914.) Price 4*s*. 6*d*. net.

THE main object of this book is to advocate modifications in our present alphabet, so as to make it suitable for representing English sounds. On plates facing pp. 142 and 144 the suggested alphabet is portrayed; the capitals are practically identical with the small letters, but slightly more ornate. A characteristic is that no letter projects above or below the line; nor are parts of each letter thicker or thinner than others; the character is what is termed "Doric." The uniformity in height of the letters makes it possible to bring the lines of print closer together, and so to save space. But, in the opinion of the reviewer, legibility is therebv sacrificed; Russian type, in which the general effect is that of printing in capitals, is not so quickly read by Russians as is English or French by Englishmen or Frenchmen. In the example given on p. 20, of printing in Doric capitals, the effect is to dazzle the eyes; it is not easy reading. The author is not sanguine as to the adoption of his scheme; but he opens the interesting question whether if our alphabet is to be modified, convenience is to be increased by carefully choosing the form of the letters.

He is a strong advocate of spelling reform, and looks on the proposals of the Simplified Spelling Society as good, having regard to the restrictions with which they have limited themselves, viz. no accents; no new letters; and as little change as may be, provided consistency is attained. The system of Ellis and Pitman, phonotype as it was called, narrowly escaped achieving success in the 'seventies; had Ellis's health not broken down, and had his type not been destroyed by a fire, it is not unlikely that steps might have been taken to introduce its use into schools. The type is easily read; it is also easily written, for the script hand is not difficult; and there is a saving of nearly 20 per cent. in space compared with ordinary spelling and alphabet. One of the most remarkable pieces of evidence in its favour is an account of an experiment by an Edinburgh schoolmaster, Mr. Williams, who "proved that children averaging five years of age could learn to read printed books in phonetic type in one-third or one-fourth the time in which children of six or seven years of age could, without the intervention of the phonetic system, learn to read the common 'Romanic' books; and when these younger children had been one session (between ten and eleven months) learning to read through the phonetic system, they could read books printed in the 'Romanic' type quite as well as the elder class which had been engaged during two sessions, or double the time, learning to read without the intervention of the phonetic system."

A considerable amount of space is occupied in a discussion of the English phonetic alphabet; that is, what English sounds should be characterised by separate characters. The point of view is that of a southern Englishman; it is too often forgotten that among English speakers they are in a small minority. A large majority, for instance, retain at all events some reminder of a trill at the end of the word "star," although in America, if the South be excluded, the "r" may be described as a buzz, rather than a trill.

In Mr. Wilde's vowel system different symbols are given to the "a" in "alms" and the "a" in "at," and quite correctly; the difficulty arises when it is realised that it is indifferent whether the first or second sound of the "a" be used in such words as "castle" or "dance." And this involves the question of a standard pronunciation, about which few people will agree. In the reviewer's opinion (to take the instance given), it is better to retain the one symbol "a" for both sounds, leaving it to individuals to pronounce the "a" as they are accustomed to do. Again, many English speakers make no distinction between the two sounds of "oo" in "boot" and "foot"; here, again, it would appear advisable to let one symbol represent both sounds.

This book is well written, and puts a case for a view of spelling reform which is not usually considered; if it should commend itself to the public to adopt new characters, no decision ought to be taken without attention to what Mr. Wilde has brought forward.

W. R.

THE INDIAN ORIGIN OF THE MAORI.

Who are the Maoris? By Alfred K. Newman. Pp. 303 + plates. (Christchurch, Melbourne, and London: Whitcombe and Tombs, Ltd., n.d.) Price 7*s*. 6*d*. net.

THE origin of the Polynesians has long been discussed by more or less qualified persons, and a general agreement has been arrived at. Mr. A. K. Newman takes up the problem where it had been left by Mr. Percy Smith, the author of "Hawaiki," and adduces a great deal of evidence to prove that the cradle-land of the race was northern India—a view, by the by, which has been held for some time by other students. He says, "By the word 'Maori' I mean the brown-skinned race called Polynesian by European writers. Maori was their own word, should always be used . . . The Maoris were the first people to discover the Pacific islands . . . Some writers talk of other races who inhabited these islands prior to their discovery by Maoris. I assert that there were never any people in these islands except the Maori." The Maori were, he claims, an "Aryan-Naga people"; he agrees they are dominantly Caucasian, but is convinced they have a large infusion of Mongolic blood, which they received, according to him, before their emigration, since he classes the Kolarians and Santals as Mongolic. He says, "centuries before India was invaded by Aryans there was an invasion from the north-west by Mongolic peoples called Scythians, or Turanians. These Mongols conquered the black aborigines and extended their dominion all over northern India. Their principal tribes were called Takkes or Nagas, Kolarians, and Santals." It is a pity that he gives no references in support of these wide statements. "In India the word Maori was variously spelt—Mauri, Maurea, Maori, Maoli, Mauli, Baori, Baoli, Kaori, Waori," for most of which he finds parallels in the Pacific, and he gives a large number of place- and tribal names, mainly in Bengal, which are similarly equated.

The author is evidently unaware of the linguistic researches of Father W. Schmidt, who showed in 1906 ("Die Mon-Khmer-Völker") that the Polynesian, Melanesian, and Indonesian are dialects of the Austronesian group of the Austric linguistic family, of which the Austroasiatic was the other group. The latter group includes the Munda, Khasi, Mon-Khmer and other languages. The Nagas may be "dropped colonies of Maoris," but surely allusion should have been made to the Khasis, who alone in Assam speak an Austric language.

Religion, mythology and various arts and crafts are alike impressed to bear witness to the Indian origin of the Polynesians and their migration through the East Indian Archipelago. There is certainly a great deal to be said in favour of the main thesis, and doubtless many of the facts adduced may support it, but the entire absence of references makes it impossible to gauge their value unless the reader happens to know the authorities. A number of parallels are cited which would equally prove an African or American affinity with the Maori. There is a good deal of repetition in this badly-arranged book, and there is no index.

OUR BOOKSHELF.

Marriage Ceremonies in Morocco. By Prof. E. Westermarck. Pp. xii+422. (London: Macmillan and Co., Ltd., 1914.) Price 12*s.* net.

It is to be hoped that Dr. Westermarck will one day give us a general work on the origin and development of social ceremonies. Ceremony is a sort of material complement to social ideas, an action-language embodying and expressing, if not imitating and compelling, the social will. Its roots are in the same soil as magic.

This very complete study, by the historian of human marriage, of the marriage ceremonies of the Moroccan peoples, includes a mass of detail, none of which is unimportant. The wealth of ceremonial possessed by Arab and Berber folk-custom is extraordinary. But in most cultures marriage tends to be more ceremonialised than any human happening. Even modern Germany, as Reinsberg - Düringfeld's "Hochzeitbuch" shows, is in this respect nearly the equal of Morocco. Most of these are what anthropologists ten years ago styled customs, but the formal "solemnity" of practically all social and most individual acts in semi-civilised societies has now been well established. It is the main character of the "religious" or "magical" stage of culture.

The betrothal, the negotiations about dowry or bride-price, the preparation of the trousseau, the arrival and reception of the bride, the meeting of bride and bridegroom (as a rule they have never set eyes on one another), these and other scenes are set off by continuous and minute ceremonial. The preservation of so many thousand details by oral tradition is an astounding feat of memory, which deserves the attention of psychologists.

In dealing with the ideas embodied in these ceremonies, the author refers to the magical theory advanced by the present writer in "The Mystic Rose," and to Mr. Van Gennep's theory of *rites de passage*, *rites de séparation*, and *rites d'aggregation*. But he recognises the extreme probability that they may have a mixed origin. Some may be prophylactic or purificatory, others mere expressions of emotion, others again may be positive and intended to promote welfare. The author does not aim at a general philosophy of ceremony; but the many points of view which the material and the comment suggest should lead to important conclusions.

The work is a splendid monograph, worthy of its author. A. E. Crawley.

A Text-book of Geology. By Prof. James Park. Pp. xv+598+lxx plates. (London: Charles Griffin and Co., Ltd., 1914.) Price 15*s.* net.

Prof. Park's mining researches have increased rather than lessened his interest in the wide fields of geology, and the present text-book adequately covers the range required for students of mining colleges and secondary schools. It is systematically divided into paragraphs, headed in thick type; facts are concisely stated, and the author's personality is not permitted to intrude.

Already, however, in history for college students—witness Prof. Bury's recent single volume upon Greece—there is a tendency to keep in view the philosophy of the subject as a higher stratum based upon the facts; and something of the kind may be possible in our text-books of science as time goes on. At present one would like to recommend a pupil to read no text-book, but to buy a number of the shilling volumes written by specialists on the lines and subjects that attract themselves. This, however, would not enable the student to meet the requirements of a university degree. Prof. Park is well aware of this, and has kept himself within traditional bounds. At the same time he makes good use of recent work, including even the Piltdown skull (p. 480); and his references to New Zealand and the southern hemisphere introduce a welcome series of examples. The illustrations are numerous and well chosen, though those of ammonites lead to the retention of a somewhat old classification. Formulæ might have been more freely utilised to show the composition of the rock-forming minerals, which are here rather loosely described. The absolutely essential boron would then have appeared as a constituent of tourmaline, and the rhombic pyroxenes would not have been defined merely as "variable silicates." "Titanite" (pp. 197 and 198) is not a synonym for the titanic iron-ores. The explanation of technical terms founded on Greek words is a very useful feature throughout the book.

G. A. J. C.

The West India Committee Map of the West Indies. Scale 55 miles = 1 in. Size 3 ft. 9 in. by 2 ft. 10 in. (London: George Philip and Son, Ltd., 1914.) Mounted on cloth and varnished with rollers, 10*s.* 6*d.*; on sheet, unmounted, 7*s.* 6*d.*

THE object of the West India Committee in issuing this map is to stimulate interest in the British West Indies. No attempt has been made to give the land relief and other physiographical features of the individual islands—the relative size of the islands in relation to the parts of the mainland shown making such a course impracticable. Prominence is given to railways, sea routes, cables, and other data of commercial importance. Three inset maps are provided: one shows the routes and distances between Canada and the United States and the West Indies, another a plan of the Panama Canal, and a third a graphic representation of the areas and populations of the islands.

The Origin of the World. A Book for Children. By R. McMillan. Pp. xiii+136. (London: Watts and Co., 1914.) Price 2*s.* net.

THE object of this little book is to explain, in language simple enough for an intelligent child to understand, the steps in the evolution of our planet, of plant and animal life, and of the human race. The book is written in a pleasant style which should appeal to young readers, arrest their attention, and engender a desire for fuller knowledge.

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.]*

Temperature-Difference between the Up and Down Traces of Sounding-Balloon Diagrams.

DR. VAN BEMMELEN'S letter in NATURE of May 14 is of great interest to me, and seems to prove an appreciable amount of lag in the instruments he uses. Every thermometer must as a matter of course have a certain amount of lag, but I have not been able in the records of the English instruments to detect any sign of it, although there is a marked distinction between records obtained at night or when the sun is low, and those obtained when it is high.

In the diagram, A is the ordinary type of a night ascent, B that of a day ascent. The double trace, one made on the ascent, the other on the descent, is apparent in about every record obtained. It is not often apparent to the naked eye, and hence the diagram is an exaggerated one, but under the microscope by means of which the records are read, the traces in type A can be seen to cross each other here

and there, in type B, on the other hand, the traces are distinct throughout, but the distance between them is plainly variable, ranging often from about 1° to about 3° C. It is very seldom that differences so large as 4° C. are found. In three cases out of four type A will occur at night, and type B when the sun's altitude exceeds 10°, but now and then type B occurs at night, and seems then to indicate an actual change of temperature during the ascent.

In the English instruments the thermograph depends on the temperature of a very thin strip of German silver; this is kept stretched by a small invar tube. The expansion of the invar is nil, and therefore its temperature is of no consequence; the German silver is 0·03 mm. thick, and exposed on both sides to the air current. It is therefore very sensitive as a thermometer; certainly much more so than the Bourdon tube or ordinary metal couple.

I have always accepted the Continental records made in the winter as being free from any systematic error, but have long felt that their summer ascents show temperatures that are persistently too high.

The policy of making all ascents at a fixed time, 7 a.m. G.M.T., seems to me a most unfortunate one

Its advantage is that it is the time of the morning weather chart, and hence the results can be plotted on the chart with the knowledge that all the observations shown are simultaneous. But the objections are twofold. In many cases figures obtained at great expense have to be rejected, because they are obviously falsified by solar radiation. This must happen if the balloon does not burst, and the sun is high, whereas if the sun is near to or below the horizon it is of no consequence if the balloon does or does not burst. This gives cause for doubt also about some of the printed figures since it is not too clear in all cases as to what may be accepted and what must be rejected. Secondly, it is impossible to get the annual or the daily variation from observations at a fixed hour. The daily variation is, of course, hopeless, and not knowing the law of the daily variation, it is uncertain whether the same correction for the hour should be applied both summer and winter. The result is that the annual variation above 12 km., as shown by the English ascents, many of which were made at sunset before the international time of 7 a.m. was fixed, differs by 3° C. from the Continental value, but it is very improbable that there is any real difference. A plan has now been adopted by which the string carrying the instrument uncoils after the balloon is started, and since last winter a very much longer string has been employed in the English ascents. This avoids the difficulty of starting with a long string in rough weather, and it will be interesting to see what effect the plan will have on the records. The change of length is from 44 to 132 ft.

W. H. DINES.

May 20.

Transmission of Electric Waves Round the Bend of the Earth.

IN a paper on the transmission of electric waves round the earth's surface, read by Prof. H. M. Macdonald before the Royal Society on February 12, some conclusions are recorded which cast new light on the problem of long-distance wireless telegraphy. Prof. Macdonald's point of view is that of simple diffraction, and the paper is the latest one of a notable series of attempts by a number of eminent mathematicians. In the present paper the author reduces his formulæ to figures, and thus makes comparison with experiment easy. The most extensive quantitative experiments yet made over great ranges are those of L. W. Austin in 1910 (Bulletin Bureau of Standards, vol. vii., No. 3), and those of J. L. Hogan in 1913 (*Electrician*, August 8, 1913). From the former experiments Austin and L. Cohen deduced a formula which has been corroborated by Hogan's results. This formula may be written:—

$$i = c\epsilon^{-ax/\sqrt{\lambda}}/(\lambda x),$$

where i is the current in amperes in the receiving antenna at the distance x kilometres for the sending station, λ is the wave-length of the radiation in kilometres, a has the value 0·0015, and c, like a, is a quantity which does not depend on λ or x. This formula was deduced from daylight experiments extending over larger ranges of λ and x than those used in the table below.

By aid of this formula Prof. Macdonald's calculations can be quickly compared with the results of experiment. In the following table the first column contains the number of miles between sender and receiver, and the remaining columns contain the ratios of the effect at various distances to that at 419 miles. R_d is the ratio, calculated on the diffraction theory, between the electric fields, R_m is the ratio found by measurement between the currents in the same receiving antenna when moved to the successive distances in turn.

Miles	λ = 320 m.		λ = 625 m.		λ = 1220 m.		λ = 2560 m.		λ = 5000 m.	
	R_d	R_m	R_d	R_m	R_d	R_m	R_d	R_m	R_d	R_m
419	1	1	1	1	1	1	1	1	1	1
536	0·304	0·481	0·392	0·554	0·464	0·605	0·537	0·660	0·585	0·693
675			0·128	0·286	0·184	0·349	0·256	0·418	0·315	0·467
814					0·0764	0·218	0·128	0·282	0·178	0·336
1070							0·0392	0·148	0·0637	0·184
1257								-	0·0321	0·134

From the table it seems fair to draw the conclusion that diffraction accounts for a large proportion of the observed effects up to distances of, perhaps, 2000 miles. The proportion is much larger than has hitherto been demonstrated, and compels the admission of diffraction into the list of phenomena contributing to the practical success of wireless telegraphy.

But the Austin-Cohen formula expresses a remarkable experimental fact which is not explained, but, rather, is contradicted by the diffraction theory; namely, that for each distance there is a best wave-length. The formula indicates that this optimum wave-length is given by $4\lambda = a^2x^2$, and, consequently, that under the best condition

$$i = 4c(a\epsilon)^{-2}x^{-3} = cx^{-3} \times 2{\cdot}140 \times 10^5,$$

for rather long ranges. These equations are, broadly, borne out by the experience of wireless telegraph engineers. The equation for λ shows that as the wave-length is increased the effect at a given place first increases and then decreases. Here the theory of diffraction appears to fail, for the diffraction effect at any fixed point should increase steadily with increase of wave-length. On the other hand, the hypothesis of the refraction of electric waves in the atmosphere when it is ionised by sunlight seems more promising. For while radiation of very short wave-length is lost into space by the rays suffering too little bending, radiation of great wave-length, by being too strongly refracted, is lost in the ground between the oscillator and the receiver; and thus an optimum wave-length is easily conceivable.

W. ECCLES.

University of London, University College, May 18.

Some Phenomena of Clay Suspensions.

THE interesting letters in NATURE on the cellular structure of emulsions induced me to test the behaviour of clay which I have been accumulating for some time for evaporation experiments. The clay is obtained by the usual sedimentation method, and is that fraction of the soil which does not settle in twenty-four hours in a beaker containing dilute ammonia to a depth of 8·5 cm. The suspension is then evaporated to dryness *in vacuo*.

If some of this dried clay be well shaken up with strong ammonia solution and poured into a Petri dish, the usual network, mentioned by Mr. Wager in NATURE for May 7, gradually develops. Occasionally a different pattern appears, only the angles of the network are formed, and the surface thus has a pitted appearance.

The pattern persists for a few minutes and then gradually becomes blurred. The two cases are shown in Figs. 1 and 2 respectively. In neither case are groups of cells formed. Although the structure is quite sharp to the eye, the lack of contrast makes the photographic difficulties considerable. I am indebted to Dr. H. B. Hutchinson and Mr. A. Appleyard for the photographs here reproduced.

A suspension of clay in alcohol gives the opposite effect; in this case the preliminary network does not seem to appear. Isolated groups or single cells form active centres, from which other cells grow until the surface is covered. The cells are nearly hexagonal and sharply rectilinear, and frequently measure half cm. in diameter. There is a light spot in the middle of each, and the particles can be seen flowing up at the middle and down at the sides of the cells. The pattern persists for a few seconds and then fades away, only to reappear after a short interval. This periodic reappearance is very fascinating to watch. In all probability it is caused by small air currents flowing over the surface of the liquid, disturbing the rate of evaporation.

FIG. 1.

FIG. 2.

I have occasionally noticed another very curious phenomenon in the beakers containing the clay suspension in dilute ammonia. Usually, after the lapse of a few hours, the brown coloured mixture increases in opacity from top to bottom of the liquid. In the case mentioned this graduation is broken by one or two colourless horizontal rings, which appear round the side of the beaker. Thus, there is an increase in opacity from the surface to a depth of one or two cm., until the first ring is reached. The layer immediately below seems to be less opaque than the layer immediately above the ring, but this may be purely an optical illusion. The liquid below the ring increases in opacity until the second ring is reached, when the appearance already mentioned is repeated.

This stratification will persist indefinitely. The rings remain unbroken and gradually sink, at a rate below one cm. in twenty-four hours, as the suspension slowly clears. The phenomenon seems to be quite fortuitous, and I have not been able, up to the present, to reproduce it at will.

It is possible that it may be related in some manner to those forces producing the cellular structure, and I should be glad if some reader could supply me with information or references to it.

B. A. KEEN.

Rothamsted Experimental Station, Harpenden.

THE KAISER-WILHELM INSTITUTE OF CHEMISTRY.

A DESCRIPTION of the objects of this Institute has already been given in NATURE of Feb. 23, 1911, in the report of a lecture delivered at the inauguration of the Kaiser-Wilhelm Gesellschaft by Prof. Emil Fischer on January 11 of that year.

The institute was formally opened by the Emperor on Oct. 23, 1912. It is divided into sections each of which is under the direction of specialists with a consultative committee of experts. Dr. Beckmann is director of the chemical section and is assisted by Dr. Willstätter, who is head of the organic laboratories, and Dr. O. Hahn, who is engaged upon the study of radioactive substances.

The institute is situated at Dahlem, not far from Berlin, and it forms a three-sided block consisting of three floors and a basement. The top floor is occupied by Dr. Beckmann and has accommodation for about a dozen workers, the first floor is apportioned to Dr. Willstätter, and the ground floor to Dr. Hahn. In the basement are installations for vacuum and pressure machines, electric motors and accumulators, liquid air plant and cold storage rooms. The ventilating exhausts are in a chamber under the roof where distilled water is prepared. The main buildings are shown in the accompanying illustration.

Main building, with director's and porter's houses, of the Kaiser-Wilhelm Institut, Berlin, Dahlem.

The first volume of researches issued by the institute and covering the period from April, 1912, to October, 1913, has recently been issued, and its chief contents are here summarised.

The first paper is a contribution by Dr. Beckmann on the use of various solvents,

$$(SO_3,\ SO_2(OH)Cl,\ CrO_2Cl_2,\ SO_2Cl_2),$$

for ebullioscopic determinations. He finds that many organic compounds give normal results in sulphonyl chloride; but that for one reason or another the others are unsuitable. In a second paper the same author describes a Bunsen burner of porcelain, its object being to prevent the coloration of the flame by metallic incrustations in analytical examinations, and so masking the presence of small quantities of salts. In a third paper the constant for iodine when used as a solvent in cryoscopic determinations, was estimated, the value found for a large number of metals and metallic iodides, varying between 200 and 211. As an ebullioscopic solvent iodine gave a constant of 102 to 107. Taking 105 as the mean, the formulæ for aluminium and ferric chloride were found to be Al_2I_6 and Fe_2I_6. As in the case of the cryoscopic method, the alkaline iodides gave abnormally high molecular weights.

In a further paper a new sodium lamp is described. It is so constructed that a spray of sodium hydroxide or carbonate is driven into a bunsen burner supplied at the orifice with oxygen. The spraying is produced by nickel electrodes let into the vessel near the bottom of the burner. In another paper which is in reality a continuation of the above, a method is described for spraying salt solutions by dropping the solutions on to a horizontal revolving disc, and has been utilised for obtaining a steady colour intensity in the flame. In collaboration with R. Hauslian, Beckmann has studied the molecular weight of selenium, which had been previously found to correspond to Se_2, as determined by its cryoscopic effect on iodine, whereas in methylene iodide and phosphorus it is Se_{10} and Se_8 respectively. They found that the dissociation of the molecule in iodine is not due to any thermal effect as sulphur has the molecular weight of S_8 under similar conditions, nor is there any union with the iodine.

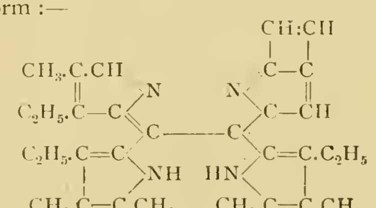
The series of papers published by Dr. R. Willstätter begins with an account of the interesting hydrocarbon *cyclo*octatetrene which he has recently prepared.

It behaves like an ethenoid compound inasmuch as it is rapidly oxidised by permanganate; is readily reduced by hydrogen in presence of colloidal platinum to *cyclo*octane, and combines with a molecule of bromine and hydrogen bromide to form $C_8H_8Br_2$ and C_8H_9Br respectively. Moreover it cannot be nitrated either by nitric acid or benzoyl nitrate. It therefore is very unlike an aromatic compound such as benzene. Like benzene, however, it exhibits no exaltation of molecular refraction nor of dispersion for $H_\beta - H_\alpha$, but, in consequence of a higher dispersion in the violet regions, shows distinct exaltation for $H_\gamma - H_\alpha$. It shows no absorption bands but selective general absorption. The pure substance has a yellow colour, and solidifies at $-27°$ to a pale yellow crystalline mass. In another paper Willstätter and King describe the preparation of dihydronaphthalene and its reduction products with hydrogen and platinum. It behaves like benzene with an unsaturated side-chain such as styrene, $C_6H_5.CH=CH_2$, inasmuch as the partly reduced ring in dihydronaphthalene is much more rapidly reduced than the other. In this respect naphthalene is sharply distinguished from dihydronaphthalene, for in the former case no tetrahydroderivative is obtained at whatever stage the reduction is interrupted, but the decahydro-compound with larger or smaller quantities of the unaltered hydrocarbon. They still leave the formula of naphthalene an open question.

In conjunction with Wirth, Willstätter has further extended the method of exhaustive methylation which he has successfully used in the preparation of dihydrobenzene, dihydronaphthalene, *cyclo*butene, *cyclo*heptene, and *cyclo*octene, to the formation of vinylacetylene, $CH:C.CH:CH_2$, from the dibromide of butadiene. It is a gas boiling at 2–3°, and forms a greenish-yellow copper salt, and a colourless crystalline silver salt.

The memoir on chlorophyll by Willstätter and Forsén, which follows, has already been published *in extenso* in Liebig's *Annalen*, vol. ccexcvi., and is a continuation of previous work on the same subject. It is concerned with methods for introducing magnesium into the porphyrin molecule by Grignard's reaction and into other chlorophyll derivatives by heating with magnesium oxide and an alcoholic potash solution under pressure.

A memoir of equal importance and closely related to the one on chlorophyll is on the structure of hæmoglobin, the red colouring matter of the blood, by Willstätter and M. Fischer. The subject has already been studied by Küster, Piloty, H. Fischer, and others. Hæmoglobin readily breaks up into hæmatin, which is a coloured body and globin, a colourless protein. From hæmatin by heating with hydrochloric acid, hæmin is obtained in reddish-brown crystals having the formula, $C_{31}H_{33}O_4N_4FeCl$, which loses its atom of iron on treatment with hydrobromic acid giving hæmatoporphorin. If the latter is treated with alcoholic potash it yields hæmoporphorin, which with soda-lime loses carbon dioxide and forms aetioporphorin, a substances identical with the product of disintegration of the chlorophyll molecule. The relation of hæmoporphorin to aetioporphorin is represented by the formulæ, $C_{33}H_{36}O_4N_4$ and $C_{31}H_{36}N_4$. As Fischer stated in his inaugural address, "this fact denotes a species of consanguinity between the animal and vegetable kingdoms. This must, however, be of great antiquity, that is to say, to date from remote times when the animal and vegetable kingdoms were as yet not distinct." As aetioporphorin can be broken down in successive stages to dimethyl ethyl pyrrole, it is possible to devise a structural formula which, according to Willstätter, takes the following form:—



Aetioporphorin

Other papers by Willstätter and Zechmeister describe the hydrolysis of cellulose by strong hydrochloric acid containing 40–42 per cent. of the gas (sp. gr. 1·2). The cellulose rapidly and easily dissolves in the strong acid, and after a time the solution contains only glucose. A method of oxidation of olefinic compounds such as tetrahydrobenzene, limonene, menthene, etc., by the use of osmium in presence of oxygen gas is the subject of a paper by Willstätter and Sonnenfeld.

In the radio-active section of the institute Drs. Hahn and Meitner have studied the question of radio-actinium and its position in the periodic system. As the radio-element evolves both α and β rays, and therefore indicates a mixture, an attempt was made, though unsuccessfully, to discover the second constituent. In order to explain the production of both kinds of rays, the authors suggest that the series may branch at uranium-X into UrX_2 and Act, with the discharge of β rays, and that in one series so produced the β-ray change is followed by the α-ray change, and in the second the reverse takes place. In a second paper they confirm the discovery of UrX_2 by Fajans and Göhring, and describe a simple method for its preparation, which consists in filtering the UrX_1 solution through a layer of moist tantalic acid. The latter retains the UrX_2, whilst the UrX_1 remains in solution with the thorium. This process is based upon the relations of UrX_1 and UrX_2 in the periodic table. J. B. C.

THE REORGANISATION OF THE FISHERY AUTHORITIES.[1]

THIS report presents the results of the latest of a long series of inquiries into the productivity and administration of the British Sea Fisheries. In many ways it is the most important document of its kind presented to Parliament during the last twenty years. Former fishery inquiries usually considered the fishing industry as it is carried on on the high seas, and international questions so greatly complicated any possible action, both with regard to scientific investigation and administration, that might have been taken that little in the way of legislation resulted from them. The Committee now reporting was appointed little more than a year ago; it has considered domestic, rather than international fishery matters; and there is every indication that its utterance represents an official desire for legislative action. Altogether the recommendations are of greater significance than those of any Committee or Commission since 1885.

These recommendations are almost revolutionary. They presuppose a coordinated and reasoned scheme of scientific investigation of the fisheries of the three kingdoms, and at the same time they urge the establishment, in England, of a public Department possessing the status, *personnel*, and equipment now enjoyed by the fishery authorities of Scotland and Ireland. In these countries there are strong central fishery departments regulating and investigating the national industries with the assistance of money directly voted by Imperial Parliament. The English Department possesses no power actually to regulate the fisheries, and until a few years ago it carried out no scientific investigation. Regulation was entrusted, in 1888, to local committees created on the initiative of county and borough councils, and deriving their revenue from local rates levied on the maritime counties. Eleven of these local committees exist at the present time, but, with the exception of the Lancashire body, they have done little to regulate methods of sea fishing, and nothing at all to investigate and develop the industry. Only by the cordial cooperation of the wealthy inland boroughs, and by amalgamation with neighbouring counties has Lancashire been enabled successfully to regulate and investigate its local fisheries, and even there scientific work has been carried on precariously and with little promise of continuity. Two lines of advance were suggested to the departmental committee, first, the amalgamation of the local authorities on the south-west, south, and east coasts into two or more bodies similar to the Lancashire committee, and secondly the abolition of the local committees and the transfer of their powers of regulation to the Fisheries Branch of the Board of Agriculture and Fisheries.

The latter course is that recommended. The local bodies are to continue to exist as small advisory councils deprived of the power of rating, or of appointing officers. Their staffs are to be transferred to the Board, along with the power of initiating and enforcing restrictions and prohibitions of methods of fishing. Local resident inspectors will be appointed to supervise the work of regulation, and to place the fishermen in touch with the local advisory committees on one hand, and the Board on the other. To all these functions will be added that of the organisation and development of inshore fishing. How this work of development will be carried out is only vaguely suggested in the report, but in the first place a Fisheries Organisation Society, on the lines of the Agricultural Organisation Society, will be founded, and will be financed by public funds. This body will promote the idea of cooperation among fishermen, will assist them in marketing their produce, in securing better means of transport, and in obtaining credit for the provision of boats, motors, and other gear. Its work will be largely propagandist at first. The Central Department itself will undertake the task of improving or constructing fishery harbours and piers, and better channels and breakwaters; of organising the shell-fisheries by means of regulating and several orders, and the provision of plant whereby such molluscs as mussels and cockles can be freed from dangerous pollution; of intervening where the rights of fishermen are threatened; and of the dissemination of intelligence of value in the disposal of the produce of the fisheries.

Scientific investigation will be maintained and amplified where it exists and instituted on those parts of the coasts where it is not yet carried out. This will be controlled and coordinated by the Board, and it is now generally known that a scheme for the adequate investigation of the fisheries of all three countries has been prepared, and only awaits sanction and the provision of very large initial and annual grants of money by the Development Commissioners before it is put in operation. That the importance of research and statistical investigation has been recognised by the Committee is apparent, but that it is all-important *before* beginning the task of repealing and simplifying regulations, or of the further development of the shell-fisheries, or the working-out of an exhaustive system of obtaining fishery statistics, has not been clearly apprehended, we think. Yet experience of the huge mass of futile restrictive legislation built up in the past should have taught them to be

[1] Report of the Departmental Committee on Inshore Fisheries. Vols. i. and ii., Report, Appendices, and Minutes of Evidence. [Cd. 7373 and 7374.] (1914.)

averse to making further radical change, or constructive legislation, before attaining much more knowledge of the natural history of the marine economic animals than we yet possess.

The weakest part of the Report is that dealing with the better education of the fishermen. It does not appear to us that the Committee has received sufficient evidence on this question, or that it made itself acquainted with the educational machinery already in existence, or even that it properly considered the admirable memorandum on this subject by the Board of Education, which is printed in the report. The Committee distinguishes between the instruction that is necessary for the inshore, and that which is necessary for the deep-sea fishermen, a distinction which it will be impossible to maintain in practice, since one class is continually being recruited from the other. The deep-sea man urgently requires instruction in working methods of navigation—much more instruction than is at present recognised except by the Board of Trade, which tends continually to raise the standard of its Fishery Examinations. The inshore man requires a knowledge of his technique, net-making, fish-curing, and the management of small boats at sea, for instance, and how this is to be acquired except by actually practising it under the instruction of older men we do not know. Both kinds of men require above all a much sounder elementary education than they at present possess—without this the further instruction will surely fail in its object. The Committee recommends supplementary courses in the elements of navigation, the natural history of the sea (without biology!), practical ropework, sail-mending, signalling, carpentry and metalwork, all for boys attending sea-board primary schools. It recommends evening continuation school courses in the same subjects, but with the addition of fish-curing for girls, and motor-mechanics for boys, these without restriction of age. It recommends occasional lectures in fishing centres in order that a knowledge of the natural history of fishes might be imparted, that the necessity for restrictions on methods of fishing might be explained, and that the resentment of fishermen to these restrictions on their operations might be obviated.

It is difficult, and there is no space at our disposal, to consider these recommendations seriously. They do not matter since the whole organisation of the elementary and technical education of fishermen, inshore and offshore, is at present being actively developed by the Board of Education and by the local authorities, and will work itself out in a satisfactory manner all the sooner under the stimulus of a reorganisation of the fishery authorities.

Apart from these defects (due obviously to the desire of the Committee to report without delay, and to the fact that its primary concern was with industrial development) the report is a statesmanlike piece of work. We cannot help feeling that now or never is the time for the reorganisation of the fishery authorities on one or other of the alternative lines suggested in the evidence, and for the strengthening and adequate equipment of the Central Department. It is also sincerely to be hoped that investigation in the widest sense, scientific and statistical and industrial, will at all steps accompany this reorganisation in order that the failures of past fishery legislation may be avoided.

J. J.

AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

AS August draws nearer the organisation of the first Australian meeting of the British Association is gradually approaching completion. The overseas party will number, roughly, 350, and will for the most part leave England at the end of June or the beginning of July. The Blue Funnel liner *Ascanius* is to convey a considerable proportion of the advance party for Western Australia, while the main body of the visitors will leave later in the Aberdeen liner *Euripides* (on her maiden voyage), and the Orient mailboat *Orvieto*. The latter will take on board at Fremantle the advance party, and will arrive at Adelaide on the same day as the *Euripides*, viz., August 8. Other lines and other routes will bring small detachments of members.

A special arrangement has been completed with the Customs Department in Australia for the speedy handling of luggage at ports of entry. Clearance will be effected very rapidly of all baggage certified to contain only personal effects. Members bringing with them anything subject to taxation will be required to make the usual statements and payments.

The matter of overland conveyance in Australia of the overseas party is one of not inconsiderable difficulty. To the lively satisfaction of the Federal Council and the various committees controlling arrangements, it was decided at a conference of the Premiers of the different States, held at the beginning of April, that the hospitality of the several State railways should be offered to all visiting members without distinction. The desire is very strong in Australia that there shall be the least possible amount of distinction made between the various members of the visiting party. Where differential treatment does come in, it is simply because the numbers in the party put equal treatment beyond the ability, though not the wishes, of Australia.

The Federal Handbook, a volume of 600 pages, is now published and about to be distributed to the visiting party by the High Commissioner for the Commonwealth prior to the party's departure. The book is the work of leading authorities of the country, and neither trouble nor money has been spared to make it worthy of the occasion of its issue. It is the intention of the Commonwealth Government to present a copy not only to each visiting member of the Association, but also to each member of its General Committee.

State handbooks, supplementary to the larger and more general work, are practically all completed, and will shortly be made available in England. Western Australia and Tasmania have decided, at a later stage than the other States, also to issue suitable books, but these will probably not be distributed before the departure of the party.

As the full programme of the meeting is still subject to amendment, it may be withheld for the present. The presidential address will be divided between Melbourne and Sydney, and the sectional presidential addresses will be distributed in the following way:—

Adelaide: Geography and Agriculture (part i.).
Melbourne: Mathematics and Physics, Chemistry, Zoology, Economics and Statistics, Physiology (part i.).
Sydney: Geology, Engineering, Anthropology, Botany, and Education.
Brisbane: Physiology (part ii.) and Agriculture (part ii.).

For ordinary business the sections will meet only in Sydney and Melbourne. Australian papers will occupy one-third of the available time in all sections, except those dealing with geology, zoology, geography, anthropology and botany, in which the proportion will be one-half. Perhaps the most important of all the local contributions will be an account by Dr. Douglas Mawson of the scientific results of the recent Australian expedition to Antarctica. Dr. Mawson is generously postponing his announcement until this meeting: it will add a very distinctively Australian element to the proceedings of several sections, particularly of that concerned with geography.

Citizens' lectures are being undertaken in each centre, either by the Workers' Educational Association, Trades-Hall or University Extension Board, or a joint committee of two or more of these bodies. The following lectures and discourses are to be delivered during the meeting:

Perth, W.A.: July 28, Why we investigate the ocean, Prof. W. A. Herdman; July 31, Stars and their movements, Prof. A. S. Eddington; August 2, The primitive methods of making fire, and their survival for ceremonial purposes, H. Balfour; August 3, The electrical action of the human heart, Dr. A. D. Waller. *Kalgoorlie*: School inspection: a review and retrospect, or Mining education in England, C. A. Buckmaster. *Adelaide*: August 10, The æther of space, Sir Oliver J. Lodge; August 11, Ancient hunters, Prof. W. J. Sollas. *Melbourne*: August 17, Mimicry, Prof. E. B. Poulton; August 18, The Greenwich Observatory, Dr. F. W. Dyson. *Sydney*: August 21, Primitive man, Prof. G. Elliot Smith; August 24, Atoms and electrons, Sir Ernest Rutherford. *Brisbane*: August 28, The materials of life, Prof. H. E. Armstrong; Wireless Telegraphy, Prof. G. W. O. Howe; August 31, The place of physiology in general education, Sir E. A. Schäfer. Public lectures (to which members of the association are not admitted as such) will also be delivered as follows:—*Adelaide*: "Saving and Spending," Prof. E. C. K. Gonner. *Melbourne*: "Brown Earth and Bright Sunshine," Prof. B. Moore; "The Making of a Big Gun," Dr. W. Rosenhain. *Sydney*: "Comets," Prof. H. H. Turner; "Clocks," Sir H. H. Cunynghame. *Brisbane*: "The Decorative Art of Papua," Dr. A. C. Haddon.

Excursions will form an exceedingly important part of the meeting. In Sydney, for example, half the total available time is devoted to them. With the exception of the special trips in Western Australia and Tasmania, and to Broken Hill, members will not be asked before their departure to make any selection. On arrival at each centre, however, they will be requested to fill in a form stating in order their preferences for particular excursions. A definite number of visitors will have been arranged for on each excursion, and allotment will be made on the basis of the preferences submitted. With the possible exception of a few of the more lengthy trips, it may now be taken for granted that no charges will be made upon excursions to members of the overseas party.

The fulfilment of the promise to extend private hospitality to most of the visitors in each centre is already assured. To the committees dealing with this matter, and in fact to all concerned with the organisation of the meeting, the high and increasing interest which is being taken by the general public in Australia is a source of very great satisfaction. An enthusiastic and successful meeting is certain.

NOTES.

We greatly regret to see the announcement of the death on Saturday, May 23, in his seventy-fifth year, of Dr. P. H. Pye-Smith, F.R.S., lately vice-chancellor of the University of London and consulting physician to Guy's Hospital.

The death, at the age of seventy-five years, is announced in the issue of *Science* for May 15, of Prof. Newton H. Winchell, formerly State geologist of Minnesota and professor of mineralogy and geology at the University of Minnesota.

Invitations have been issued by the president of the Royal Society, chairman of the General Board of the National Physical Laboratory, to meet the board at the laboratory on Friday, June 19, when the various departments will be open and apparatus will be on view.

The sixth informal spring foray of the British Mycological Society will be held in the Forest of Dean from Friday, May 29, to Tuesday, June 2. Daily forays will be made, from the Saturday to the Tuesday inclusive, and the various places to be visited will be selected on the previous evening.

The council of the Institution of Electrical Engineers has appointed Mr. W. Duddell, F.R.S., Mr. F. Bailey, Mr. K. Edgcumbe, Mr. Haydn T. Harrison, and Prof. J. T. Morris as delegates to the British National Committee of the International Illumination Commission, and will contribute equally with the Institution of Gas Engineers towards the expenses of the committee.

An exhibition of photographs by Mr. A. Radclyffe Dugmore, the African traveller and author of many works on photographing big game in their native haunts, is being held at the house of the Royal Photographic Society, 35 Russell Square, W.C., from May 27 until June 13 (Whit Monday and Tuesday excepted), between the hours of 11 a.m. and 5 p.m., free to the public on presentation of visiting card.

The value of the discovery of flint implements of a very primitive type by Mr. Reid Moir at Ipswich has been widely recognised. The work of exploration has hitherto been carried on by the aid of a grant from the Royal Society. An appeal, which we trust will meet with adequate support, for a fund to assist the work has been issued by Sir A. Geikie, Sir Ray Lankester, Sir A. Evans, Sir H. Read, Prof. Marr, and Messrs. W. Whitaker and Henry Balfour. Sir Ray Lankester, whose address is 331 Upper Richmond Road, Putney, S.W., has consented to act as treasurer of the fund.

We regret to announce the death by drowning in Ceylon of Mr. E. R. Ayrton, the Archæological Commissioner of the island. Mr. Ayrton was a valued officer of the Egyptian Exploration Fund, in which he served with Prof. Petrie at Abydos, with M. Naville and Mr. H. R. Hall at Dêr-el-Bahri, and then with Mr. Thomas Davis at the Tombs of the Kings, contributing largely to his success. He afterwards resumed explorations at Abydos, and elsewhere for the Egyptian Exploration Fund, by the members of which he was held in great respect. After a course of studies in Indian languages, he was appointed on the Archæological Survey of Ceylon, where he cooperated with Mr. H. C. P. Bell in his archæological work. His untimely death will be regretted by all students of Ceylonese antiquities.

On Tuesday next, June 2, Prof. A. Fowler will begin a course of two lectures at the Royal Institution on celestial spectroscopy; on Thursday, June 4, Prof. Silvanus P. Thompson will deliver the first of two lectures on Faraday and the foundations of electrical engineering; and on Saturday, June 6, Mr. S. Goetze will commence a course of two lectures on studies on expression in art. The Friday evening discourse on June 5 will be delivered by Prof. W. H. Bragg on X-rays and crystalline structure, and on June 12 by his Excellency the Hon. Walter Hines Page (the American Ambassador) on some aspects of the American democracy.

After the erection of the memorial window to Lord Kelvin in Westminster Abbey, there was a balance in hand from the fund collected for this purpose. This is to be disposed of by the establishment of a Kelvin gold medal to be awarded triennially as a mark of distinction achieved in engineering work of the kinds with which Lord Kelvin was especially identified. The award will be made on each occasion by a committee consisting of the presidents of the Institutions of Civil, Mechanical, and Electrical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, and the Institution of Mining and Metallurgy, after the consideration of recommendations to be invited from the principal engineering societies in all parts of the world.

The first meeting of the International Scientific Radio-Telegraphic Commission was held in Brussels on April 6, Mr. W. Duddell, F.R.S., Dr. W. H. Eccles, and Dr. E. W. Marchant representing Great Britain. The other members of the British National Committee are Prof. G. W. O. Howe, Sir Oliver Lodge, F.R.S., Sir Henry Norman, M.P., and Prof. Silvanus P. Thompson, F.R.S. It will be remembered that this International Scientific Radio-Telegraphic Commission was founded in October last for the purpose of carrying out scientific experiments in wireless telegraphy, and that by the generosity of Mr. Goldschmidt, of Brussels, the use of a large wireless station and the sum of 50,000 francs was placed at the disposal of the commission. Measurements are being made of the strength of the signals sent out from Brussels. The National Committee of each country represented on the commission organises the method of making the measurements, and arranges with experimenters to carry them out.

A correspondent writes:—"By the death of Miss Freund (Nature, May 21, p. 299), for many years lecturer in chemistry at Newnham College, Cambridge, science has lost a devoted follower, chemistry an enthusiastic and original teacher, investigator, and writer, and her friends a wise, warm-hearted, and gentle woman. During most of her life Miss Freund laboured under a great physical disability; but she was always in her laboratory, guiding, encouraging, directing her students; whenever she had a spare hour or two she was pursuing some piece of investigation, and for many years she spent much time in the vacations in writing that remarkable book on 'Chemical Composition,' which made her well known to all chemists. Miss Freund was a genuine student of science; her work is marked by thoroughness, lucidity, sound judgment, suggestiveness, and grasp of the relative importance of different classes of facts. It is known to her friends that she was preparing a book on practical chemistry; should the manuscript be sufficiently advanced for publication to be possible, not a few teachers of chemistry will welcome the book with enthusiasm, not a few will be astonished at the thoroughness and the boldness of it."

Mr. William West, of Bradford, died on May 14 at his residence in Bradford from heart failure. He was a native of Woodhouse, Leeds, where he was born February 22, 1848, so that he was in his sixty-seventh year. He was brought up as a pharmaceutical chemist, carrying on business in Little Horton Lane, Bradford, in which town he settled about 1872. More than a decade later he gave up that business on becoming lecturer in botany, biology, pharmacology, and kindred subjects at the Bradford Technical College. He was a most successful teacher, and his students kept up their attendance at his classes even after the completion of their necessary courses. It is stated that his success in sending up students to the Royal College of Science was remarkable, and it is largely owing to his influence, example, and teaching that Bradford possesses an unusual number of investigators in natural science. His elder son, William West, jun., a most able botanist, died of cholera in India within a fortnight of landing to take up a biological appointment;

and the younger son, George S. West, is the present professor of botany in the University of Birmingham. Mr. West was a keen and accomplished all-round botanist, with a special preference for the cryptogamia. Of late years, in association with his son George, he concentrated upon the study of Desmidiaceæ from all parts of the world, their papers, severally and jointly, being very numerous. The monograph of British Desmidiaceæ is in course of publication by the Ray Society.

LAST Friday the directors of the Cambridge Scientific Instrument Company entertained a large company at their works, among whom were many of the leading men of science in Cambridge and their lady friends. The occasion marked the completion of a further extension of the works, by which an additional floor area of 6,740 sq. ft. is provided to meet the growing necessities of the business. The works were thrown open to the visitors, who availed themselves of the privilege of passing through the various departments and inspecting the process of manufacture from raw material to finished product. A very interesting and instructive exhibit of instruments was provided, and many were to be seen in operation, and were explained by members of the staff to interested groups. We cannot do more than touch upon a few of the instruments displayed amongst a wide variety which attracted merited attention. An aerodynamic balance, which has been made for the new aeronautical laboratory of the Massachusetts Institute of Technology, possesses the latest refinements for investigating the reactions upon aerofoils, a form of instrument which is sure to play a large part in the study of these problems. The string galvanometer with double vibrator arranged for electro-cardiographic work was seen in operation, the action of the heart being shown on a screen. Another instrument shown was the crack micrometer, for determining the movement taking place in cracked masonry. Two steel pins are cemented into the masonry, one on each side of the crack, and the micrometers are applied to ascertain the relative displacement in three dimensions. This instrument is used in St. Paul's Cathedral. A very comprehensive series of pyrometers was shown, including the Féry radiation and absorption pyrometers, and the Whipple-Féry closed tube pyrometer, also an automatic temperature regulator for maintaining the temperature in a gas-heated molten metal bath. Among other instruments of precision were the Darwin extensometer, Boys's radio-micrometer, and galvanometers and electroscopes of various types, besides many other instruments in great variety.

THE issue of the *National Geographic Magazine* for April is chiefly devoted to a singularly interesting account by Mr. J. C. White of the little-known State of Bhutan in the lower Himalaya. A fine series of photographs adds to the value of this contribution. The writer gained the confidence of the present ruler, Maharaja Sir Ugyen Wang Chuh, who provided ample facilities for exploration. Mr. White gives an enthusiastic account of the people and their country, with its varied scenery and flora, the latter including rare varieties of orchids. He shows ample reason for rejecting the views of a high Indian official, who, so late as 1890, wrote:—"No one wishes to explore that tangle of jungle-clad and fever-stricken hills, infested with leeches and the pipsa-fly, and offering no compensating advantages to the most enterprising pioneer. Adventure looks beyond Bhutan. Science passes it by as a region not sufficiently characteristic to merit special exploration."

MR. C. CARUS-WILSON described in NATURE of September 28, 1911 (vol. lxxxvii., p. 415) the "Earthquake House" erected at Comrie in 1872 through the combined efforts of the British Association and Mr. Drummond. He has now sent us a photograph of the house, and it is reproduced in the accompanying illus-

The "Earthquake House" at Comrie.

tration. It may interest seismologists to know that Mr. Carus-Wilson is exhibiting a model of the early form of seismometer used in the "Earthquake House" in the Science Section of the Anglo-American Exhibition at Shepherd's Bush, where the details may be studied.

IN the May number of the *Irish Naturalist* Dr. H. Stokes records the result of digging for remains of the "Irish elk" in bogs at Howth and Ballybetagh, County Dublin. In the latter locality no fewer than twenty-two more or less imperfect skulls, together with a number of broken bones, were discovered; but at Howth, which had been previously worked, only three skulls and three skeletons were obtained. In Mulligan's Bay, County Wicklow, two skeletons, six skulls, and five shed antlers were dug up.

THE *Malta Chronicle* of May 1 announces the discovery on "Il Gebla tal General," otherwise known as "Fungus Rock," in the island of Gozo, of a new local form of the wall-lizard, which has been named (where not stated) by Dr. G. Giulia *Lacerta muralis*, var. *generalensis*. It is stated to have the back black with yellowish-green spots, the flanks bluish, the under-parts brick-red, the legs black, and the tail maroon, with a black tip. Specimens of the Gozo wall-lizard are, we understand, *desiderata* in the Natural History Museum.

IN the *Field* of May 23 is reproduced a lithograph, drawn by G. Scharf, and printed by Hullmandel in 1836, representing the four Nubian giraffes brought to London in May of that year by Mr. Thibaut, the agent of the Zoological Society, and his party of Arab attendants, all of whom are included in the picture. In the heading to the accompanying letterpress it is stated that these were the first living giraffes received in England; but the writer has evidently forgotten George IV.'s giraffe, received at Windsor in 1827, of which an account is given by Mr. Lydekker in the Zoological Society's Proceedings for 1904 (vol ii., p. 339).

As reported in the *Times* of May 21, an international conference was held last week at the Foreign Office, with Lord Chelmsford as president, for the purpose of devising more efficient measures for the protection of elephants and rhinoceroses in Africa The conference, which included representatives of all European States possessing territory in Africa, was summoned at the instigation of Mr. Woosnam, the game-warden of British East Africa. Existing regulations for the protection of elephants and rhinoceroses are, it appears, not observed equally throughout African territories; and without such equality it is obvious that their efficiency must be greatly impaired. One of the points in which revision of existing legislation is imperative relates to the size of elephants' tusks for export. According to the *Times* of May 26, the conference is understood to have finished its labours and to have arrived at an agreement, which, when ratified by the Governments concerned, will prove a distinct step in advance. The recommendations to the respective Governments are believed to include the formation and maintenance of sanctuaries for elephants and rhinoceroses in suitable localities. The shooting of these animals is to be permitted only on licences, the conditions of which are to be made as nearly as possible identical in the different territories. In the case of rhinoceroses, absolute protection is recommended for a number of years, and, as regards ivory, the standard weight for export is to be raised to 10 kilos, or more than 22 lb.

THE Board of Trade and the Natural History Branch of the British Museum are to be congratulated on the results of their joint efforts to obtain a census of the number of cetaceans stranded annually on the British coasts. The scheme was initiated in 1912 by the issue of a circular to Receivers of Wrecks, instructing them to report by telegraph to the museum all cases of stranded whales, porpoises, and dolphins that came under their notice. This was followed by the issue in 1913 to coastguard officers of a leaflet intended to aid in the identification of species, and to indicate the essential points of distinction between a porpoise and a shark—animals which, strange to say, are frequently confounded with one another by non-scientific persons. The results of the census are summarised by Dr. S. F. Harmer in a "Report on Cetacea Stranded on the British Coasts during 1913," just issued by the British Museum (price 1*s*. 6*d*.) The total number of stranded cetaceans reported during that year was seventy-six, a few of which were, however, sharks. The identification of species, as might have been expected, was not very satisfactory, but the inquiry, as shown in maps accompanying the report, has brought out very clearly the fact that the great bulk of the strandings occurs on the east coast, especially in Norfolk and Lincolnshire, during the late summer and autumn. To what extent this is dependent on the migrations of herrings is a question which cannot at present receive a decisive answer. Incidentally, the census has been the means of securing a certain number of specimens of the rare species for the museum.

DURING the five years it has been in existence, the International Institute of Agriculture has performed a useful function by publishing monthly a bulletin of agricultural intelligence and plant diseases. In addition to a very large number of abstracts of scientific papers with an agricultural bias, the current number (vol. v., No. 3) contains original articles by recognised authorities on agricultural education in the Argentine, moor cultivation in Germany, entomological work in Hungary, and the cattle industry in Britain. The latter paper, by Prof. Robert Wallace and Mr. J. A. S. Watson, raises several interesting points on the rise and fall in the number of the different classes of live stock during the period for which trustworthy data are available. Since 1878 the number of cattle in the United Kingdom has shown a steady increase from $9\frac{3}{4}$ millions to almost 12 millions, while the number of sheep in the same period has shown somewhat rapid fluctuation without any marked tendency either in one direction or the other. There is a large export trade in pedigree cattle from Great Britain, and during the five years 1906–10, this averaged almost 5000 head, of which rather more than 3000 were breeding animals of an average value of about 60*l*. On the other hand, a very large importation of young store animals and others ready for fattening is carried on, the extent of which may to some extent be judged from the fact that Ireland supplies about half a million stores annually. The increased attention which is being devoted to the improvement of dairy stock is reflected in the very rapid development of milk record societies and also in the greatly increased prices that are now being paid for pedigree dairy stock.

THE Geological Society of Glasgow has always been noted for the original researches published in its Transactions, and it is fortunate in the cooperation of professional workers and keen local amateurs. The discussions are reported, and this is usually a stimulus to debate. In part i. of vol. xv., published in 1914, Alexander Scott reviews the pitchstones of Arran, and shows that the order of crystallisation of the constituents and the occurrence of tridymite raise questions of interest in view of modern researches on silica and the silicates. A. Stevens takes us as far as Stornoway, and suggests that the coarse conglomerate, so well seen east of the town, and generally regarded as a relic of Torridonian strata, may be in reality of Triassic age. G. W. Tyrrell, dealing with the Carrick Hills near Ayr, furnishes one of his careful studies in petrography. J. W. Gregory, attracted towards geographical subjects, uses the Campsie Fells as a text for an essay upon cirques. Matthès's observations on "nivation," which leads to the sinking of a snow-patch into a hollow worked out by frost and thaw upon its margins, might well be added to those quoted in favour of the "meteoric theory" of the origin of cirques. The edges of certain plateaus in Spitsbergen, as Prof. Gregory knows better than most geologists, afford excellent evidence of the potency of "nivation." This paper will lead to the further consideration of one of the commonest and most puzzling surface-forms of our British highlands.

A VERY elaborate gravimetric survey of Italy has been undertaken by Prof. V. Reina and Dr. G. Cassinis, the observations being published in the *Memorie della R. Accademia dei Lincei*, vol. ix., p. 5. The apparatus used consisted in a modification of Sterneck's pendulum, the apparatus being connected with a wall table with a bipendular support. The stations chosen were Rome, Leghorn, Arcetri, Genoa, Vienna, and Potsdam, the two latter serving as bases of comparison. The uncorrected values observed for g at these stations exceeded 980 by 0·367, 0·534, 0·491, 0·557, 0·860, and 1·275 cm./sec.^{2}, and the corrected values reduced to sea-level by the use of various formulæ are in every case, except one in excess of the values, calculated for the corresponding latitude from the Potsdam formula, the excesses being in every case less than 0·1 cm./sec.^{2}.

THE present year marks the tenth anniversary of the Aerodynamic Institute of Koutchino, which was founded on the initiative of its director, Dr. D. P. Riabouchinsky, for the purpose of researches on fluid pressures and other problems connected with aerial navigation. The main laboratory is equipped with wind tunnels, whirling tables, apparatus for testing propellers, and, in short, all the necessary appliances for experimental work, while attached to the institute there is a hydrodynamic laboratory where use is made of a small river called the Pékhorka. The staff consists of Dr. Riabouchinsky, three assistants, six mechanics, and several workmen. The published work alone includes investigations on propellers, rotation of plates and oscillation of pendulums in a current, and effects of the size of tubes on air currents passing through them, as well as papers of a more mathematical character. A descriptive pamphlet has been published in connection with the present occasion. It is printed by J. N. Kouchnereff, of Pimenoskaïa, but is probably obtainable from the director. It might, however, have been safer if Dr. Riabouchinsky had left the question of locomotion through interplanetary space to M. Jules Verne and Mr. H. G. Wells.

THREE communications from the physical laboratory of the University of Leyden which have reached us are of exceptional interest. The first is a reprint of the address which Prof. Onnes delivered before the Swedish Academy on the receipt of the Nobel Prize for 1913. It describes the apparatus and the methods adopted for the production of extremely low temperatures at Leyden, and is well illustrated. The second is a report by Prof. Onnes to the third international congress on refrigeration held at Washington and Chicago last year. It deals with the work done in the professor's laboratory since the last meeting of the congress in Vienna. The chief results relate to radio-activity, magnetic susceptibility and electrical resistance at temperatures down to 2° or 3° absolute. Radio-activity remains unchanged, the susceptibility of paramagnetic substances decreases below the values given by Curie's law of variation inversely as the absolute temperature, and in some cases reaches a maximum and decreases for temperatures lower still. The resistivities of metals decrease and almost disappear at temperatures 10° or 20° above the absolute zero. The third paper is a report to the same congress on low-temperature thermometry by Prof. Onnes. He advocates the substitution of the helium for the hydrogen thermometer as the standard scale for low temperatures. If the nitrogen thermometer has to be substituted for the hydrogen thermometer at high temperatures, he would suggest that the helium scale should extend up to 100° C., and the nitrogen scale begin at that point. As auxiliary thermometers for low temperatures he recommends platinum or gold resistance thermometers, but in both cases it is necessary to calibrate the resistance thermometer by comparison with a helium thermometer at a considerable number of points on account of the strong curvature of the resistance-temperature curve at very low temperatures.

As a supplementary note to the article on the "Total Eclipse of 1914 in Turkey and Persia," which appeared in last week's NATURE, attention should be directed to the Map of Armenia by the late H. F. B. Lynch, on the scale of 1 : 1,000,000, published by Mr. Edward Stanford, Ltd. The map is in a very useful and portable form, and covers the whole country from Trebizond to Tabriz. It can be obtained apart from Mr. Lynch's book.

OUR ASTRONOMICAL COLUMN.

COMET 1914*b* (ZLATINSKY).—A Kiel circular dated May 20, and an appendix to *Astronomische Nachrichten*, No. 4736, give the following elements and ephemeris, calculated by Prof. H. Kobold, of Zlatinsky's comet (1914*b*), based on observations on May 16, 17, and 18:—

Elements.

$$T = 1914 \text{ May } 8{\cdot}3618 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 116^\circ\ 17{\cdot}85' \\ \Omega &= 32\ \ 43{\cdot}22 \\ i &= 112\ \ 56{\cdot}31 \end{aligned}\right\} 1914{\cdot}0$$

$$\log q = 9{\cdot}73478$$

Ephemeris 12h. Berlin M.T.

	R.A. h. m. s.	Dec. ° ′	Mag.
May 27	7 12 42	+31 30·6	5·8
28	7 25 55	28 37·9	
29	7 37 41	25 49·5	6·1
30	7 48 8	23 7·4	6·2
31	7 57 30	20 33·2	
June 1	8 5 51	18 7·6	
2	8 13 19	15 51·1	
3	8 20 2	13 43·7	6·7
4	8 26 5	+11 45·0	

At the time of discovery this comet was observed to be of the fourth magnitude, so it is rapidly diminishing in brightness. It is situated in the constellation of Gemini, not far from Castor and Pollux. Owing to an error in the original telegram from the discoverer, his name was wrongly recorded.

NOVA NO. 2, PERSEI.—Some very interesting observations relating to the changes of magnitude of Nova No. 2, Persei, have recently been communicated to the Monthly Notices of the R.A.S. (vol. lxxiv., No. 6, April) by Mr. C. R. D'Esterre. This observer uses comparatively small instruments, his largest aperture being 15 in. (reflector), yet with two hours' exposure and most careful following he can photograph stars down to magnitude 19·3. From observations extending from September 1911, to April of the present year, he has been able to establish an interesting degree of variability in the light of the above nova, duplicate exposures with other instruments corroborating his statements. While the mean magnitude of this object during the above period is given as 12·3 mag., there has been a range of variation between 11·7 mag. and 13·2 mag. The fluctuations are described as irregular and rapid, but these have now decreased, and the nova is staying at almost a constant but fainter magnitude. The decline in magnitude has not been accompanied by any marked change of colour. Mr. D'Esterre publishes the individual observations in the paper so that they form a valuable series to link up with those of other observers.

OBSERVATIONS AT THE LOWELL OBSERVATORY.—Lowell Observatory Bulletin No. 59 summarises in thirty-one brief paragraphs the visual and photographic work that has been carried on during the period April, 1913, to April 14, 1914. The list is too long to refer to in detail, but the following notes may be given. Confirmation and completion of the detection of spoke-like markings on Venus, making them a distinguishing feature of the topography of the surface. Determination of the rotation period of Mars giving 24h. 37m. 22·57s. Observations of the canals and oases as fine geometrical lines and dots with the full aperture of the 40-in. reflector. Variability in brightness of the third or fourth satellites of Saturn and measures of the planet's ball, ring, and satellites. Numerous deductions are next given from the photographs taken with slit and slitless spectrograms of the nebulæ in the Pleiades, Cygnus, gaseous nebulæ, nebulæ, and globular clusters, etc. Velocity of approach to the sun of the nebula of Andromeda is given as 300 km. a sec. Spiral nebulæ as a class have a much higher order of velocity than have the stars.

THE SPECTRA OF δ CEPHEI AND ζ GEMINORUM.—A study of the relative changes of intensity in the lines (dark) in the spectra of δ Cephei and ζ Geminorum is described by Inna Lehmann in the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg* (No. 6, 1914, p. 423). The spectra of the two stars discussed were taken at the Pulkowa Observatory, and there were available thirty-three plates of δ Cephei and thirteen of ζ Geminorum. The method of procedure was to select one plate as a specimen, and then to compare each of the others with it by means of a spectro-comparator, and thus determine the relative intensity of selected lines. For both stars details are given as to the lines chosen, their wave-lengths, the resulting comparisons, etc. Forming the normal values of the intensities estimated, and comparing them with the light phases, it is found that in the case of δ Cephei when the lines are best visible the star is at a minimum brightness and *vice versâ*. On the other hand, the curve representing the relative intensity-change of the lines in the spectrum of ζ Geminorum are not parallel with the light fluctuation of the star. Four days after the minimum, when the light curve is at a maximum, there is an undoubted diminution in the intensity of the lines.

THE BRITISH SCIENCE GUILD.

THE eighth annual meeting of the British Science Guild was held at the Mansion House on Friday, May 22, the Lord Mayor presiding over a distinguished and representative gathering. The report of the year's work was presented by Sir Boverton Redwood, who directed attention to matters of special importance dealt with by the committees of the guild.

Amongst other matters the medical committee had prepared a well-considered report on the subject of venereal diseases which had been presented to the Royal Commission now considering the matter. Also a warning had been issued to the general public against the danger of fraud in connection with the sale of substances or waters as curative agents, in which radium is said to exist, and the danger of being harmfully treated by persons with no medical qualifications.

The report of the Canadian Committee attracted special interest. Amongst other matters attention was directed to the serious effect of the wholesale slaughter of native insect-eating birds in view of the destruction of agricultural and forest products by insect and other pests. Insects disseminate malaria, yellow fever, typhoid, and other pernicious diseases. Nevertheless, millions of people engage in destroying the birds that eat destructive and disease-spreading insects. In this connection it is satisfactory to note that, in this country, the Bill to prohibit the importation of the plumage of wild birds has just passed the Committee stage of the House of Commons.

Mr. Charles Bathurst, M.P., the chairman of the Select Committee on the Ventilation of the House of Commons, expressed his indebtedness to the guild for its valuable help in connection with the scientific investigation of the matter.

A feature of the meeting was an address by Sir Ronald Ross on the encouragement of discovery, in which he sought to show that of all the labours which man can undertake those which issue in discovery have conferred the greatest benefits upon mankind. He maintained that in the encouragement of science the public omits the main consideration, namely, the purchase of genius. Our universities are largely paid for by private individuals, and the money spent by them is spent more upon teaching than upon discovery. Sir Ronald Ross deprecated the inadequacy of the steps taken to persuade the individuals capable of making discovery to devote themselves to this great task. This could only be done by making it worth their while. If the nation wishes to stimulate discovery, which includes science, to the utmost, it should not only provide universities, institutes, and research laboratories, but should endeavour also to attract by adequate material recognition the most capable men to a field of work which yields the most valuable results to humanity.

The annual dinner of the guild was held in the evening at the Trocadero Restaurant, with Sir William Mather in the chair. The chairman, in proposing the toast of "Science and Industry," commended a spirit of optimism, and said that the twentieth century might probably reveal still greater wonders than the nineteenth. Sir Alfred Keogh, who responded, said that the public administration of this country owed a great deal to science and particularly to Sir Ronald

Ross in regard to his discoveries in connection with deadly tropical diseases. Science was everything to industry, and man found that money profits could be made by taking advantage of the advances of science. He was an optimist about industry, but he could not be an optimist when he looked round and saw members of his profession who had laboured for nothing, scarcely even the thanks of the public, certainly without those rewards for which those engaged in industry rightly and properly looked. He referred also to the fact that the headmasters of the public schools generally were clergymen, and deprecated the lack of provision made in those schools for scientific instruction.

Sir William Byrne (Home Office), in proposing the toast of "The British Science Guild," said that he agreed with the statement in the annual report of the guild, that Government Departments used the services of scientific men without remuneration. The charge was irrefutable. Virtue might be its own reward, but science rarely was. He sympathised with them, and promised that so far as he was concerned he would do his best to alter this state of things.

FLUIDS WITH VISIBLE MOLECULES.

PROF. JEAN PERRIN (of the University of Paris) in his recent course of lectures at King's College, London, dealt with aggregates of suspended particles regarded as fluids consisting of visible microscopic molecules. The Brownian movement of such particles appears to be due to molecular agitation, suggesting that particles in suspension function as enormous molecules. If this is so, the laws of gases extended by Van't Hoff to solutions apply also to dilute emulsions consisting of uniform grains, and from a knowledge of the osmotic pressure of this "gas of visible molecules," one can calculate, using Avogadro's law, the ratio of the masses of the grains to those of the molecule of any gas, an indefinite vertical column of emulsion in equilibrium having the properties of a miniature atmosphere.

Suitable emulsions are prepared by isolating uniform particles of precipitated resin by fractional centrifugalisation. Such emulsions obey the laws of gases and give the correct value for Avogadro's number N, whatever the size of the particles.

Since dilute emulsions obey the laws of gases concentrated emulsions should behave analogously to compressed fluids, and the equation $(P+a/V^2)(V-b)=RT$, be applicable, where V represents the volume of the emulsion, b is four times the volume of the grains present, and a a constant which in Van der Waals's equation corresponds to cohesion. Experiment, while verifying the prediction, shows the interesting peculiarity that in the case of emulsions the cohesion constant is negative, the grains repelling one another appreciably. This result allows the experimental determination of the thickness of the double layer of electrification by contact, and throws light on the properties of colloidal solutions.

The Brownian activity of a grain is defined as E^2/t, where E^2 is the mean square of the displacement in the time t. An emulsion should diffuse as a solution of visible molecules with a speed proportional to the speed of the molecules which compose it. It can be shown that the speed of diffusion D is $1/6\ E^2/t$, and since in the steady state as many molecules pass upward through any level by diffusion as pass downward through the level by gravitation, Einstein's equation holds, viz. :—

$$\frac{E^2}{t}=6D=\frac{RT}{N}\frac{1}{\pi r z},$$

where r is the radius of the grains and z the viscosity of the intergranular fluid. Thus both by measuring the rate of diffusion and by measuring the displacement Avogadro's constant has been determined.

Emulsions were prepared of such a nature that those grains touching one side of the retaining vessel became attached and the emulsion progressively weaker by diffusion, the variation with time in the number of grains captured giving a measure of the rate of diffusion.

By selecting relatively large spherules it was found possible to measure their rate of rotation, and thus verify Einstein's formula for the Brownian movement of rotation.

These theories also apply to grains suspended in a gas except that Stokes's law is no longer applicable, but by applying an electric field to the charged particles Townsend's equation for the diffusion of ions relates the charge on the granule with Avogadro's number and the activity of its Brownian movement.

$$Ne=\frac{RT}{D}\frac{u}{H}=6RT\frac{t}{E^2}\frac{u}{H}.$$

The values of N, the number of molecules in a cubic centimetre of a gas under standard conditions, deduced by these various methods, exhibit a remarkable concordance. Prof. Perrin concluded his lectures with a critical comparison of the results of his measurements of N with the values which have been deduced from determinations of the charge of an electron, from counting alpha particles, and from the theory of radiation.

CONTRIBUTIONS TO VERTEBRATE PALÆONTOLOGY.

THE skull of a remarkable new generic type of horned dinosaur (*Styracosaurus albertensis*), from the Cretaceous of the Red Deer River, Alberta, is described and figured by Mr. L. M. Lambe in the *Ottawa Naturalist* for December, 1913 (vol. xxvii., pp. 109–16, plates x.–xii.). It was found by the well-known collector Mr. C. H. Sternberg, last summer. The skull is long, depressed, and wedge-shaped, with a single nasal horn of somewhat unusual shape; but its chief peculiarities are the large size of the supratemporal fossæ, and the production of the hind border of the great occipital flange into four pairs of spines, of which the three innermost on each side are very long. Although the Alberta horned dinosaur may be generically identical with an imperfectly known species from the Cretaceous of Montana, referred by Cope to the genus Monoclonius, under the name of *M. sphenocerus*, it is considered that the two are specifically distinct.

According to an article by Mr. C. Schuchert on the dinosaurs of German East Africa, published in the *American Journal of Science* for 1913 (vol. xxxv., pp. 33–8), the largest representative of the genus first described as Gigantosaurus, but now known, on account of the preoccupation of the original name, as Tornieria, is believed to have been about twice the length of Diplodocus, or at least 150 ft. The neck appears to have exceeded that of the American species by a length of about 15 ft. It is hoped to set up a skeleton of this gigantic reptile in the Berlin Museum.

At the conclusion of a note on the relationship between the Permian reptiles of South Africa and those of Russia, published in the *Journal of Geology* for November and December, 1913 (vol. xxi., pp. 728–30), Dr. R. Broom expresses the opinion that the dicynodonts of the Durna valley represent the Cistecephalus zone in Africa, which contains dicynodonts of very similar type. If this be so, the Cistecephalus zone will be topmost Permian, and the underlying Pariasaurus zone Middle Permian.

In an article in the February number of the *American Naturalist* Prof. E. C. Case shows that the "sail-backed" reptile, *Edaphosaurus cruciger*, of which a restoration is given, is perfectly distinct from the genus Dimetrodon, with which it had been incorrectly identified. So far from the two being identical, Dimetrodon was carnivorous, whereas Edaphosaurus probably subsisted on molluscs or insects, with perhaps an occasional vegetable meal. Unlike most of its reptilian contemporaries, its head was small in proportion to the body; the dentition consisted of a marginal series of sharp conical teeth, and of crushing teeth on the palate, the latter opposed by a corresponding series on the inner side of the lower jaw.

We have received a corrected copy of a reprint from Dr. L. Reinhardt's "Vom Nebelfleck zum Menschen" (second edition), issued as an appendix to Dr. H. Hallier's "Der Stambaum des Pflanzenreiches" (Munich), which is being completed by Dr. Reinhardt himself. This appendix, in addition to a table exhibiting the geological succession of the leading groups of plants and animals, as exemplified in central Europe, contains a number of phylogenetic "trees" illustrating the evolution of animals and of plants, as well as of many of their classes and orders. Many criticisms of these "trees" might be made, but it must suffice to mention that the author regards the toothed whales as descended from early carnivorous, and the whalebone whales from primitive herbivorous mammals. Mammals themselves he derives from Permian "Urreptilien," which in turn gave rise to "Sauromammalien," a group from which the carnivorous theriodonts are expressly excluded.

In an article published in the *Bull. Amer. Mus. Nat. Hist.* for 1913 (vol. xxxii., pp. 261–274) Prof. H. F. Osborn shows that a skull from the Eocene of Wyoming described by Cope in 1884, and referred to the genus Triplopus, under the name *T. amarorum*, really belongs to the Chalicotheriidæ, or perissodactyles with edentate claws, of which it is the earliest known representative. It is consequently made the type of a new genus, Eomoropus, which is believed to be a specialised offshoot from the stock which gave rise to the titanotheres, on one hand, and to the forerunners of the horse group on the other.

Three publications dealing with the horse family and its extinct forerunners have been issued recently in America. The first, entitled the "Evolution of the Horse," takes the form of a fully illustrated guide to the members of the group exhibited in the American Museum of Natural History. In the first part, Dr. W. D. Matthew discusses the evolution of the horse group in nature, while in the second Mr. S. H. Chubb deals with the origin of the domesticated breeds of the horse, and the structure, growth, and succession of the teeth, this latter section forming a really valuable contribution to science. In a memoir published by the Irving Press, New York, under the title of "The Horse, Past and Present," Prof. H. F. Osborn treats of the same collection, and also of the members of the horse family now living in the New York Zoological Park. In the third publication, which is in the form of a guide-book to the remains of extinct perissodactyles allied to the existing horse group preserved in Yale University, Dr. R. S. Lull records the various expeditions—starting from 1870—which have contributed to the collection, and concludes with a brief summary of the equine pedigree.

THE ROYAL SOCIETY OF TASMANIA.[1]

To commemorate the seventieth anniversary of the foundation of the Royal Society of Tasmania the secretary, Mr. E. L. Piesse, has prepared a valuable sketch of its history. The society dates from October 24, 1843, and therefore from a quarrelsome epoch of Tasmanian history. Its founder, Sir John Eardley Wilmot, had landed as Governor before arrival of the news of Sir John Franklin's recall, and an uncomfortable situation was relieved by Wilmot's undertaking a tour in the northern part of the island until Sir John Franklin had time to vacate Government House. Sir John Franklin in 1838 had established a Society for the Promotion of Natural History in Tasmania, and after a nameless existence it adopted in 1842 the title of "The Tasmanian Society." With characteristic generosity Lady Franklin established a Franklin Museum about three miles from Hobart, and endowed it with 410 acres of land. A museum building in a classic style of architecture was erected, but in consequence of uncertainty as to the ownership, owing to vagueness in the deed of gift, Lady Franklin's ideas have not been carried into effect. Shortly after his arrival, Eardley Wilmot determined to reconstitute the Tasmanian Society; but its members were mostly Franklinites, and all but five of them withdrew from the meeting, owing to disputes over unimportant details.

The Governor and those who remained then established a new society under the name of the Botanical and Horticultural Society of Van Diemen's Land. Its main objects, according to the charter, were "to develop the physical character of the island and illustrate its natural history and productions." Next year Queen Victoria became the patron of the society. It accordingly became the Royal Society of Van Diemen's Land, a title which was necessarily changed in 1855, when the name of the colony was altered to Tasmania. The older Tasmanian Society was merged in the Royal Society in 1848, and in the same year the society established the Tasmanian Museum, and in the next year commenced the publication of its Papers and Proceedings. In 1860 the site of the present museum in Hobart was given to the society by the Government, and the new museum was finished in 1862, and extended in 1886 and 1901. The society has done excellent work by the formation of valuable Tasmanian collections and by the publication of its papers and Proceedings, which are one of the main storehouses of information on the natural science of Tasmania.

Mr. Piesse's paper is published in the volume for 1913, which also includes a series of valuable contributions to knowledge of Tasmania. Mr. Rodway, the Government botanist, contributes a monograph on the Tasmanian mosses, including short summaries of all the species known in the island. These belong to 114 genera

Mr. Beattie reprints with explanatory notes a list of words used by the Oyster Bay tribe; the list was compiled in 1824, and has only recently been discovered. Dr. Noetling describes a section near Hobart, and insists that all the fossiliferous beds of southern Australia, which have long been generally assigned to the Eocene, are at the earliest Miocene. This conclusion is further supported by the description of a fossil whale from Wynyard on the northern coast of Tasmania, by H. H. Scott. Mr. Piesse contributes two papers on proportional representation, which is adopted in Tasmania. J. W. G.

[1] Papers and Proceedings of the Royal Society of Tasmania for the Year 1913. 337 pp., 1 text-fig. 22 plates, 1 map. (Hobart, 1914). Price 15s.

UPPER AIR RESEARCH.[1]

THERE are several ways of obtaining a knowledge of the free air: the observer himself may go up in a balloon and take readings of his instruments; or he may send up recording instruments in a kite, a captive balloon, or a free balloon; in the latter case, he must take the chance of the balloon and the instruments being found after they come to earth.

The first actually to use a kite for scientific purposes was Dr. Alexander Wilson, of Glasgow, who, in 1749, raised thermometers by this means; he used several kites distributed along the line, and he says that on one occasion the top kite "reached an amazing height, disappearing at times in the white summer clouds." Three years later, Benjamin Franklin made his famous experiment with a kite.

Kites with thermometers attached were used in Arctic voyages in 1821, and again in 1836; and in 1847 a kite was flown at Kew Observatory with which it was hoped to measure temperature and wind velocity. But these were isolated attempts, and it was not until the last quarter of the nineteenth century that the method was systematically adopted. The modern exploration may be said to begin with the late Mr. Douglas Archibald, who saw all the possibilities of the method, though his own work was confined to observations on wind velocity. He was the first to use steel piano wire for kite-flying, and he was able thus to get far greater heights than was possible with a line. In 1885, and the years immediately following, observations on electric potential were made by means of kites in Germany and in America. About 1890 Mr. Eddy, in America, devised a tailless kite, and raised thermometers by its means; but the great advance came when the box-kite, invented by Hargrave, of Sydney, was used instead of the older pattern. Since 1895 the Hargrave kite, or some modification of it, has been almost exclusively used in scientific kite-flying. One of the pioneers of upper air research was Prof. Lawrence Rotch, of Blue Hill Observatory; he adopted the Hargrave kite, and used steel piano wire in 1895, and in the following year he raised instruments to a height of 8000 ft. The United States Weather Bureau was so impressed with the success of the Blue Hill kite flights that they organised seventeen stations, and hoped to make daily flights for the construction of synoptic charts at a height of a mile. The experiment failed owing to the light winds in summer, but a large number of observations were taken extending over several months.

Fig. 1.—Kite-flying, Pyrton Hill.

From this time onward the work spread rapidly; it was taken up by M. Teisserenc de Bort at his observatory at Trappes, near Paris; by Dr. Assmann in Germany; and subsequently by many others; it has now become part of the ordinary routine work of any observatory that deals with the upper air.

In this country, however, we lagged behind. It was not until 1901 that a joint committee of the British Association and of this society took up the work. Prof. Rotch had shown that it was feasible to fly kites from a steamship, and in the summer of 1902 Mr. Dines, at the request of the joint committee, flew kites from a steamship on the west coast of Scotland, using a kite of his own, a modification of the Hargrave pattern.

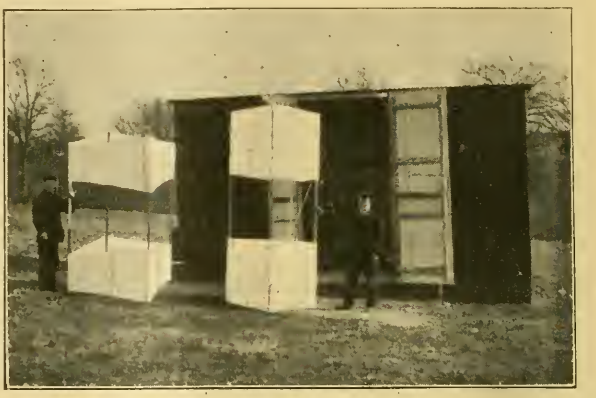


Fig. 2.—Kites (Dines pattern) ready for use.

In point of time kites for meteorological purposes preceded balloons, but serious work began soon after the invention of the balloon in 1783. In 1784 Dr. Jeffries made an ascent and took with him a barometer, a thermometer, and a hygrometer, besides bottles filled with water, which were to be emptied at various heights, and corked up again to obtain samples of air. In 1804 both the St. Petersburg Academy and the French Academy of Sciences arranged balloon ascents for scientific purposes. Very remarkable were the experiments of Thomas Forster in 1809. He filled a number of small balloons with "inflammable gas," and watched their movements; we must certainly look on him as the pioneer of pilot balloon observers, and it is strange that his method of observation was neglected for three-quarters of a century.

Fig. 3.—Kite folded for carrying.

In the middle of the last century there was a considerable increase in the interest taken in the upper air. John Welsh, of the Kew Observatory, made several ascents in 1852, and used the aspirated thermometer for the first time. Then came Glaisher's famous ascents, twenty-eight in all, some in a balloon made by Coxwell, a famous aeronaut, some in public balloons, in which Glaisher went as an ordinary passenger. Only seven ascents were specially high, and one on September 5, 1862, was the highest ever made

[1] From a presidential address delivered before the Royal Meteorological Society on January 21 by Charles J. P. Cave.

until recent years. The estimated height was 37000 ft., but Glaisher lost consciousness for thirteen minutes, and his estimate is therefore uncertain; the highest point may not have been much more than 30,000 ft.

In 1875 the French Academy of Sciences arranged for an ascent, and M. Gaston Tissandier and two companions ascended to a great height; in spite of oxygen inhalations, however, his two companions lost their lives, and Tissandier himself barely escaped asphyxiation when the balloon reached a height of 28,000 ft. This disaster prevented any very high ascents for some years, but in 1894 Dr. Berson made the first of his series of ascents that have eclipsed all previous records. In July, 1901, Berson actually took a reading of the barometer corresponding to a height of 34,500 ft. or $10\frac{1}{2}$ km., and in spite of oxygen inhalation, he, too, became unconscious This may be taken as the highest ascent yet made by man.

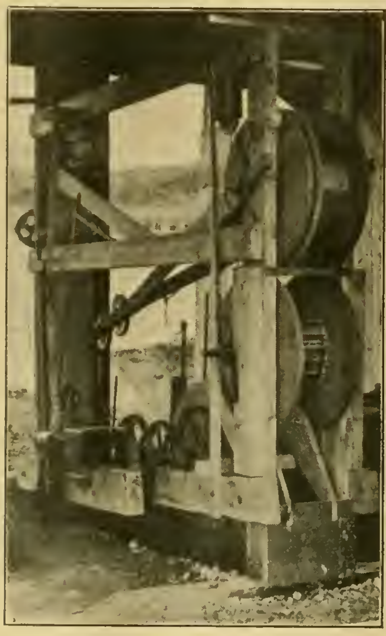


FIG. 4.—Dines winding-gear for kites.

The danger to life at great elevations led to another method of research. In 1891 M. Bonvallet sent up a number of paper balloons carrying post-cards asking the finder to post them, with a note of the time and place of finding. The experiment was repeated by MM. Hermite and Besançon with larger balloons and simple recording instruments. One of these balloons having reached a height of 30,000 ft., they made a still larger one, provided with a better recording instrument. This was the earliest registering balloon, and it made its first ascent on March 21, 1893, reaching a height of 15 km., or nearly $9\frac{1}{2}$ miles. In Germany these experiments were soon repeated. Under the auspices of the German Society for the Promotion of Aerial Navigation, Dr. Assmann sent up a balloon which rose to a height of about 22 km., or $13\frac{1}{2}$ miles. These were sensational experiments, but they seem to have attracted little attention in this country.

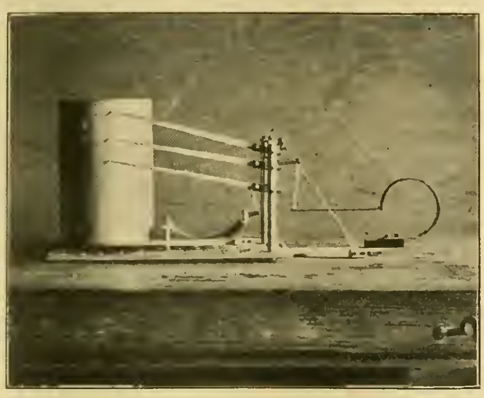


FIG. 5.—Balloon meteorograph with Bourdon tube barometer and bimetallic thermometer.

In the very early days of kite-flying ordinary minimum thermometers used to be sent up; but when the study began seriously, special instruments had to be designed. In the ordinary pattern, pens, actuated by some form of barometer, thermometer, and hygrometer, trace a record on a revolving cylinder. For the barometer an ordinary aneroid box was used at first, but this has given place in most of the instruments used on the Continent to a tube which acts in the same way as the Bourdon tube pressure gauge. The same system was used for the thermometer, the tube being filled with spirit, the expansion or contraction of which changed the shape of the tube. But a bimetallic thermometer has also been much used; this consists of a coil of metal made of two pieces which expand or contract at different rates with rise or fall of temperature. In both thermometers the resulting motion is communicated to the pen by levers.

In this country we are badly situated for balloon work; many of our free balloons are lost in the sea, and we cannot count on Government support in the research as can some of our more fortunate neighbours. I think I am not overstating the case if I say that but for the ingenuity of Mr. Dines we should have had practically no upper air research in this country. In his light balloon meteorograph he has made one of the most striking meteorological instruments. It costs in shillings what the other instruments cost in pounds; and, weighing as it does under two ounces with its case, it can be sent up with quite small balloons. An aneroid box, as it expands with decrease of pressure, carries two pens across a copper plate; the thermometer pen is moved by the relative contraction of a strip of German silver compared with an invar steel bar. Two lines are thus scratched on the copper plate; the length of the lines from the origin represents the pressure, and their distance apart the temperature. The trace is very minute, the whole plate being about the size of a postage stamp, and it has to be read under a microscope; but the expansion and contraction of the thermometers used in the Continental meteorographs have to be magnified mechanically, and, as Mr. Dines has pointed out, the optical magnification is perhaps less liable to error. The instrument is so small that some who had used the other instruments looked on it as a toy rather than as a serious instrument. But it was soon found to give as good results as the other forms; and when at Manchester University twenty-four balloons carrying these instruments were sent up in the space of twenty-four hours, one each hour, it made a considerable

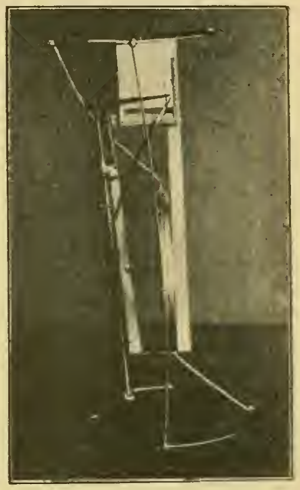


FIG. 6.—Dines light meteorograph.

impression. Such an achievement with the larger instruments would have cost more than 500*l.* in instruments alone.

When sending up one of the Continental instruments it is usual to have two balloons made of rubber fabric, one being given rather more lift than the other; the instrument, placed on a bag of nickel paper, open at both ends, to protect it from the direct rays of the sun, is slung below the balloon. The balloons ascend until one of them bursts; the remaining balloon cannot support the instruments, but it has sufficient lift to allow them to descend gently and without injury to the earth's surface. In the case of ascents made at sea a float is attached below the instruments, and the unburst balloon, which has not been given enough lift to support the float and the instruments, has sufficient lift to keep the instrument clear of the water. The unburst balloon, whether on land or at sea, is a signal to show where the instrument has descended. Sometimes only one balloon is used, but in this case it is necessary to have a parachute so arranged that when the balloon bursts the parachute will come into action and bring the instruments down in safety. Mr. Dines's meteorograph is so light that the fabric of the burst balloon is sufficient to check the velocity of descent; and these instruments have over and over again fallen from heights of ten miles or more with no ill result whatever.

FIG. 7.—Trace and calibration marks, Dines meteorograph.

FIG. 8.—Sounding balloon with parachute.

FIG. 9.—Captive balloon at M. Teisserenc de Bort's observatory at Trappes.

M. Teisserenc de Bort used paper balloons; and that they might ascend at a regular pace they carried a sandbag with a hole in it, so that the balloon was always dropping ballast. In order that the balloon might not float at the greatest height attained, there was an arrangement actuated by clockwork whereby after a certain time a hook tore a rent in the lower part of the balloon, while the upper part became a parachute which allowed the instruments to fall slowly.

Small captive balloons have been used with success for lifting instruments in calm weather, when it is desired to explore the air up to heights of a kilometre or so; but they cannot attain any very great height, as they have to lift the wire that holds them; they are apt to become very unmanageable if even a slight wind gets up while the flight is in progress. In Germany and Austria the balloon-kite has been used with success; it is a captive balloon of a form so designed that the wind lifts it instead of depressing it, as it does an ordinary captive balloon.

FIG. 10.—Landing the captive balloon.

A balloon in its ascent gives us more information than merely the temperature and pressure of the air through which it rises. If we watch it we see it moving in varying directions as it passes through different currents of air in its ascent. We have only to watch the balloon through the telescopes of theodolites to obtain its real path through the atmosphere, from which may be deduced the wind velocities and directions in the various layers. For this purpose we may use balloons scarcely larger than a child's air-ball, and, given a clear sky, we may follow such balloons up to heights of 5 or 6 km. The larger balloons used for carrying instruments can be followed with the theodolite for much greater distances; and I have myself seen a balloon burst at a height of ten miles above the surface of the earth and at a horizontal distance of forty miles.

FIG. 11.—Austrian military balloon kite.

For observing balloons in this way a special theodolite is advisable, for the ordinary pattern, when used for high angular altitudes, necessitates extremely uncomfortable attitudes on the part of the observer.

Various ingenious pieces of apparatus have been designed in connection with upper air research. I should like to mention two of them. M. Teisserenc de Bort made an apparatus for collecting air at great altitudes. In this instrument (Fig. 13) a small weight is released electrically, when a lever connected with a barometer makes contact with a metal stud; the guillotine drops on to the finely drawn out end of a glass tube, which has been exhausted and sealed up; thus air is admitted to the tube. As the balloon ascends higher the barometer moves the lever still further until it makes contact with another stud which allows an electric current to flow through a platinum wire coiled round the remaining part of the fine end of the tube, thereby melting the glass and sealing up the tube. M. Teisserenc de Bort collected samples of air in this way.

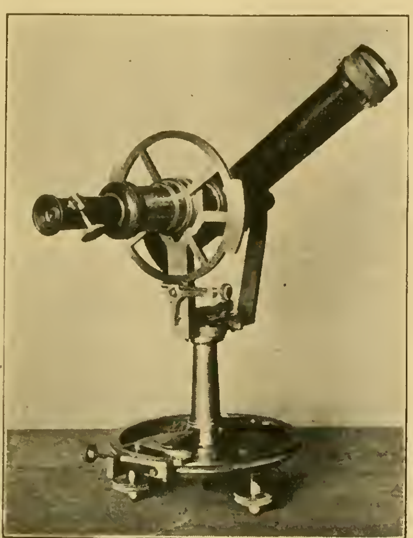


FIG. 12.—Duquervain theodolite for observing pilot balloons.

The second piece of apparatus which I will describe was designed by Dr. Assmann (Fig. 14). It is meant to measure the temperature of the air over the sea, desert countries, or in Arctic or Antarctic regions, when there is little chance of recovering the balloon. The balloon is watched through theodolites, and its height from minute to minute is calculated in the ordinary way. An arm attached to a thermometer completes an electric circuit at a predetermined temperature, say at freezing point; the electric current explodes a firework hung below the balloon, and the observer sees a puff of smoke as soon as the balloon has entered a layer of air in which the temperature is at the freezing point. Other fireworks can be exploded in turn at predetermined temperatures, and it can be arranged that the fireworks connected with the various temperatures should show smoke of various colours, so that in the event of any particular firework accidentally failing to explode the colour of the next puff of smoke will show the temperature.

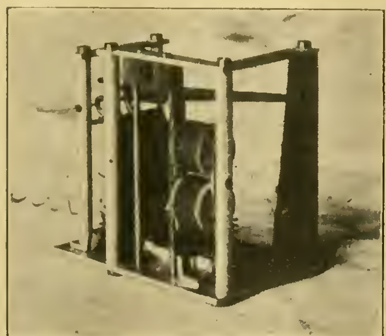


FIG. 13.—Teisserenc de Bort's apparatus for collecting air at great altitudes.

In the first part of this address I gave a short history of upper air research up to the year 1896. Before that time the research had been tentative and spasmodic; susequently it has been regular and organised. In 1896 the International Meteorological Committee constituted an auxiliary committee under the name of the International Commission for Scientific Aeronautics, with Prof. Hergesell, of Strassburg, as its president. It was agreed that simultaneous observations should be made with kites, registering balloons, and manned balloons. The first of these international ascents was made on November 14, 1896, and on that day three registering balloons and five manned balloons ascended in France, Germany, and Russia. Since that time the work has gradually extended; and at the present time international ascents are made on the first Thursday in each month, on three successive days three times a year, and once a year balloons are sent up on each day for a week.

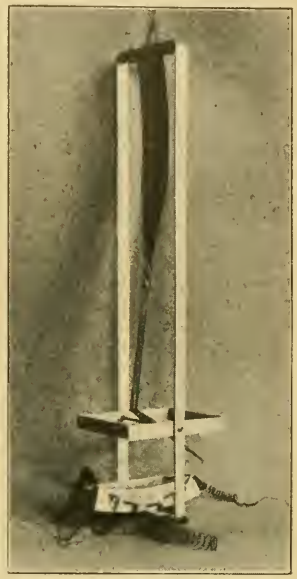


FIG. 14.—Assmann's apparatus for measuring temperature at great heights over the sea.

Meanwhile congresses have been held at Strassburg in 1898; at Paris in 1900; at Berlin in 1902; at St. Petersburg in 1904; at Milan in 1906, at Monaco in 1909; and at Vienna in 1912. The next conference is to be held in England in 1915, and it is to be hoped that in this country we shall do as much for our meteorological guests as they have done for us when we have visited them.

Meanwhile the work of exploring the upper air has been progressing steadily, and other countries joined the three which began the research. In this country, however, we were again behind. In 1903, the year after Mr. Dines had commenced flying kites, Mr. P. Y. Alexander obtained the apparatus for registering balloon ascents, and about half a dozen balloons were sent up from Bath under the superintendence of Dr. Mansergh Varley. Nothing more was done in this country until 1907, when Mr. Dines had made the instrument that I have described. The first record to come back was from a balloon which Mr. Dines

FIG. 15.—Sounding balloon at Ditcham, January 25, 1907.

himself sent up on June 5 of the same year. By the end of July the first international week took place, during which special efforts were made to get observations in the upper air, not only at the regular observatories, but by special expeditions to suitable localities. The number of foreign Government expeditions sent out to take observations in the international weeks in 1907 and 1908 is remarkable; it is also remarkable that England, the geographical position of which makes her more dependent on weather than many Continental States, and which has a larger navy than any, was entirely unrepresented officially, and would have been unrepresented altogether had it not been for private effort. But by the time of the first international week Mr. Dines had perfected his meteorograph and several observers had made themselves familiar with balloon work, and therefore this country was fairly well represented.

There are now many observatories in all parts of the world which take part in the organisation. Among others that have recently been established may be mentioned Simla, under Dr. Walker; Helwan, in Egypt; Teneriffe; and a station in Uruguay. Particularly to be noted, also, is the station in Spitsbergen, where German observers remain not only in the summer, but through the winter also, to study the atmosphere in the Arctic regions; and also the station at Batavia, in Java, where Dr. van Bemmelen is doing such excellent work on the winds in the upper air over the equatorial regions.

The most complete observatory for upper air research is that at Lindenberg. This observatory was founded under the direct personal interest of the Kaiser, and under the direction of Dr. Assmann has carried out an immense amount of work with kites, captive balloons, and registering balloons. Ascents of one sort or another are made on every day in the year, and on the international days a large number of ascents are made on each day. You will realise the immense amount of work done when I mention that in 1912 there were twenty-six ascents of registering balloons, 262 of captive balloons, and 516 of kites. The Kaiser has also shown his interest in the subject by giving to the International Commission a transportable observatory that, in the first instance, has been erected on the Peak of Teneriffe, where the Spanish Government now proposes to build a permanent observatory.

The Blue Hill Observatory, near Boston, which belonged to Prof. Rotch, has since his death been carried on by Mrs. Rotch; the observatory is now to be carried on for five years under the direction of Prof. McAdie, who is to take up the post of professor of dynamical meteorology at Harvard. It is to be hoped that some permanent arrangement will be come to whereby the observatory at Blue Hill may continue; for it was here that so much pioneer work was done by Lawrence Rotch, whose untimely death was such a loss to science and to his friends.

Another pioneer and a charming personality has also died, when it might have seemed that many years were before him to carry on his favourite study; I mean Léon Teisserenc de Bort, who only a few years ago received the Symons gold medal from this society. His death leaves his observatory at Trappes without a director. I believe, however, that arrangements have now been made by which it will be taken over by the French Government in connection with aviation.

But it is not only in the permanent observatories that work is being done. No expedition for scientific exploration would be complete to-day without some means of studying the upper air. Dr. Simpson worked with balloons in the Antarctic in Captain Scott's expedition; and both Captain Amundsen and the Danish Expedition to Greenland propose to study the upper air.

Many expeditions have been dispatched for the sole purpose of aerological research. M. Teisserenc de Bort and Prof. Rotch chartered a steamer, which, in the years 1905, 1906, and 1907, traversed various parts of the eastern Atlantic, between the temperate zone and the equator, and obtained most interesting results from their observations. The Prince of Monaco made several cruises in his yacht, the *Princess Alice*, in company with Prof. Hergesell, notably to the neighbourhood of the Canaries and to Spitsbergen.

As Lindenberg is the most complete aerological observatory, so it has sent out what was perhaps the best equipped expedition; this was organised by Dr. Assmann for the study of the upper air in tropical Africa. Under the charge of Dr. Berson twenty-three ascents of registering balloons were made from a steamboat on the Victoria Nyanza from July to September, 1908; great heights were reached, and valuable results obtained: much work was also done with kites and pilot balloons. In the international week

FIG. 16.—The Windlass House at Lindenberg.[1]

in July of the same year Prof. Palazzo made some ascents with registering balloons from an Italian cruiser in the neighbourhood of Zanzibar.

The most recent aerological expedition is one organised by Mr. P. Y. Alexander to study the upper air over the valley of the Amazons; this, too, has been put under the charge of Dr. Berson.

The *Scotia*, which was sent out to the parts of the North Atlantic where ice is frequent, also carried balloons and kites, and Mr. G. I. Taylor was able to carry out observations in a part of the globe where upper air work had not been tried before.

I have attempted to give you a short history of upper air research up to the point it has reached to-day; I have refrained from giving you the results that have been gathered from the research.

From this brief and necessarily incomplete account you will realise that upper air research is a cooperative study. The single observer out of touch with others can do little; more perhaps than in most sciences, it is the trained and united army that succeeds. And this is not the least of the charms of the science. I can personally testify how English and American, French and German, Russian and Scandinavian are all ready to help each other. There is no jealousy in the upper air. International barriers are broken down.[1]

[1] The author is indebted to Prof. Assmann, Director of the Lindenberg Observatory, for the photographs reproduced in Figs. 10 and 16.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Higher Education Subcommittee have presented to the London County Council Education Committee an important report on the recommendations of the Royal Commission on University Education in London, generally approving the proposals of the Commission with reference to the government of the University. The subcommittee considers that the Senate should have full and effective control, both educational and financial, over the proposed constituent colleges, without reference to the provisions of existing Acts and Charters. Upon this understanding, it is regarded as essential that the Imperial College of Science and Technology should become a constituent college of the University. The appointment of a small Senate, non-representative in character, is also approved, but exception is taken to the proposed constitution of the Committee of Technology, particularly in regard to the representation of constituent colleges on such committee. Recommendations are also made as to widening the representation of teachers in the membership of the re-organised faculties.

At the meeting of the Senate on May 20, Prof. E. G. Coker was appointed to the chair of civil and mechanical engineering, tenable at University College, in place of Prof. Jeffcott recently appointed to the chair. Dr. Coker is at present professor at the Finsbury Technical College, and formerly held an appointment at the Gill University.

Dr. Frank Horton has been appointed to the chair of physics tenable at Royal Holloway College.

The D.Sc. degree in botany has been granted to E. J. Schwartz, an external student.

The result of the poll for the election of a member of the Senate by graduates in science shows that Dr. M. O. Forster, who was elected, obtained 796 votes, against 293 cast for his opponent, Dr. Forster Morley.

MANCHESTER.—It is proposed to confer the following honorary degrees:—*Litt.D.*: Prof. E. K. Gonner, University of Liverpool; Prof. A. Feuillerat, University of Rennes. *D.Sc.*: Prof. W. H. Bragg, University of Leeds; Prof. W. J. Pope, University of Cambridge; and Dr. J. E. Stead, Middlesbrough.

THE honorary degree of Doctor of Engineering has been conferred upon Commerzienrat Carl Paul Goerz, the head of the well-known Goerz Optical Works, by the Technical High School in Charlottenburg, in recognition of his efforts in the development of the German optical industry in the advancement of photographic optics, and in the construction and technical improvement of optical and measuring instruments.

WE learn from the issue of *Science* for May 15 that the gifts to Oberlin College for various purposes during recent months amount to nearly 38,000*l.*, apportioned as follows:—For campus improvement, 5000*l.*; for a new art building, 25,000*l.*; for a new organ in Finney Memorial Chapel, 5000*l.*; subscriptions toward the new athletic field, 2860*l.* A large number of gifts, mostly anonymous, go to make up the 25,000*l.* for the new art building.

IT was announced in several daily papers last week that the University College of Wales, Aberystwyth, had received a gift of 75,000*l.* for the establishment of a school of music. We are informed that the report was unauthorised and inaccurate, and that the facts are that a donor who does not wish his name to be made public has agreed to guarantee the sum of 3000*l.* per annum for a period of five years in order to enable the college to found a school of instrumental music. The school will be opened next October.

THE council of the University of Birmingham invites applications for the chair of physics, vacant by the death of Prof. J. H. Poynting. The stipend offered is 750*l.* a year. The regulations state that it will be the duty of the professor appointed to contribute so far as in him lies to the advancement and diffusion of knowledge, especially by the prosecution and promotion of original research; to give instruction in accordance with the curriculum prescribed by his faculty and the Senate in his subject; to undertake necessary examining work; and to take part in the organisation of the work of the University. Applications should be sent to the secretary of the University on or before October 15 next.

PROF. JOHN PERRY, F.R.S., has recently retired from the staff of the Imperial College of Science and Technology, and a fund is being raised for the purpose of giving expression to the appreciation of his services to the teaching of mathematics and to engineering education. An appeal for subscriptions has been issued to his former students and colleagues at the Imperial College and at Finsbury Technical College, but there are doubtless many others who have benefited by his published works and will desire to subscribe to the testimonial fund. It is to be hoped that there will be a ready response, so that the committee will be able to commemorate his work in a fitting manner. Past and present students of the Imperial College should also notice that another fund is being raised for a testimonial to Prof. J. Harrison. Subscriptions should be sent to the hon. treasurer, Mr. P. T. Wrigley, Royal College of Science, South Kensington.

MUNIFICENT gifts to the University College of South Wales and Monmouthshire were announced a few weeks ago, and were referred to in NATURE of May 14 (p. 287). We understand that the facts connected with the recent donations to the college are as follows:—Last year Sir William James Thomas, of Ynyshir, undertook to build and present to the college on a site contiguous to the old buildings in Newport Road a complete physiological department, so constructed as to form a part of a scheme for a complete medical school on the same site. This year a donor, who wishes at present to remain anonymous, has offered to build the whole of the buildings necessary not only for a medical school, but also a school of preventive medicine, at an estimated cost of 60,000*l.* One of the conditions attached to the latter gift, however, is that the funds supplied by the Treasury should be sufficient for the upkeep of the complete school; and it remains to be ascertained whether this condition can be fulfilled.

THE movement inaugurated a few months ago to develop as completely as possible the educational side of the kinematograph made definite headway on Wednesday, May 20, when the Educational Kinematograph Association was formed at a meeting in London. Among those who have joined the council of this body are Sir H. A. Miers, Rt. Hon. Sir Horace Plunkett, Dr. C. W. Kimmins, Prof. R. A. Gregory, Prof. J. W. Gregory, Mr. C. Bathurst, M.P., Dr. Lyttelton, Mr. A. P. Graves, Prof. Darroch, Sir Edward Anwyl, Sir Harry R. Reichel, Sir Bertram Windle, Sir Albert Rollit, and Gen. Sir R. Baden Powell. At the meeting a report was presented by the secretary, Mr. Morley Dainow, on behalf of the provisional committee, suggesting that the work of the association should be to encourage the best types of kinematograph production and develop a completely educational plan for their use. The report was adopted, subject to revision by a sub-committee. The following officers were elected vice-presidents:—Sir Wm. Chance, Dr. Kimmins, Col. Sir J. R. D. Smith, Sir Albert Rollit. An executive committee representative of educational and social welfare associations, was also appointed, and Mr. Morley Dainow was elected secretary; communications should be addressed to him at 22–24 Great Portland Street, London, W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 21.—Sir William Crookes, president, in the chair.—Prof. W. M. **Hicks**: The effect of the magneton in the scattering of α rays. The presence of a magneton in an atom must exert some effect in scattering α or β particles passing through the atom. In order to test the order of magnitude of the effect, the orbits of charged particles moving in the equatorial plane of a magneton are discussed, and it is seen that the scattering produced is very considerable. The nearest approach of an α particle to the centre of the atom is of the same order as in Rutherford's theory. The electrostatic repulsion of an α particle combined with the magnetic field of the atom will therefore be more effective, as the diminished velocity will render the particle much more susceptible to the magnetic forces.—Hon. R. J. **Strutt**: Luminous vapours distilled from the arc, with applications to the study of spectrum series and their origin.—I. (1) It is known that mercury vapour distilled away from the arc *in vacuo* remains luminous for some distance away from the region of discharge. It is now shown how to observe brilliant effects of the same kind from a large number of other metals. (2) As the luminous vapour moves away from the region of discharge, the rate at which different constituents in the spectrum die out is not always the same. Both the subordinate series of lines in the sodium spectrum die out at the same rate, but the principal series dies out more slowly. The lines belonging to any given series always die out at the same rate, but another series may or may not die out at the same rate as the first. (3) In some cases the glowing vapour distilled from the arc shows a band spectrum. The alkali metals show a continuous band beyond the limit of the subordinate series like that seen in absorption in the hydrogen stars.—W. T. **Pawlow**: The ionisation of gases by collision and the ionising potential for positive ions and negative corpuscles.—C. E. **Stromeyer**: The determination of elastic limits under alternating stress conditions. The present paper deals exclusively with the question of endurance or fatigue qualities of metals. The apparently incongruous results obtained by previous experimenters, including those by Wöhler, made it appear probable that samples taken from different parts of a bar or plate might differ so much in quality that the law of fatigue would be masked by local variation of quality. The test pieces of the present first series (*bending*) were therefore shaped in such a manner that consecutive pieces were separated from each other in the original plate by only one inch. The test results were found to be very consistent and could be expressed by the formula $S_n = Fl + C(10^6 : N)^{\frac{1}{4}}$, where S_n is the nominal alternating stress which will cause fracture after N repetitions, Fl is the fatigue limit found by extrapolation from a series of tests resulting in fracture, and C is a constant. A comparison was made of previous tests with the help of this formula, and it was found to agree well with those of Wöhler, Baker, and Eden, Rose and Cunningham. The torsion fatigue tests were made with the same materials as used in the above tests, and the results also agreed very closely with the above formula, except that new values for Fl and C were found. The inquiry was extended to the measuring of the heat generated during fatigue tests. G. W. C. **Kaye** and W. F. **Higgins**. The emission of electricity from various substances at high temperatures. Experiments have been conducted at temperatures from 2000° to 2500° C. within a carbon-tube furnace at atmospheric pressure. Under these conditions the electrical emissions, in the absence of any applied potential, have been measured for a number of substances (including the alkaline earths and the metals tin, aluminium, iron, and copper) on their introduction into the furnace. During their rapid volatilisation the substances gave out large amounts of electricity which, with one exception, were negative in sign. For example, barium oxide and alumina generated negative currents of the order of 4 amperes per sq. cm., boiling tin about 2 amperes per sq. cm., and boiling iron about 1 ampere per sq. cm. Boiling brass, on the contrary, produced a positive current of about 0·5 ampere per sq. cm. The results have interest in connection with the problems of solar magnetism.

Linnean Society, May 7.—Prof. E. B. Poulton, president, in the chair.—H. N. **Ridley**: The botany of the Utakwa Expedition, Dutch New Guinea. The extensive collection of plants made by Mr. C. B. Kloss during Mr. Wollaston's expedition to Mt. Carstensz, Dutch New Guinea, in 1912–13, is the most important collection of New Guinea plants brought to this country. In spite of the large collections made by Dutch and German collectors, there are upwards of five hundred new species and eight new genera in the collection, many of great interest. The plants were collected at various heights from sea-level to an altitude of about 13,000 ft., where vegetation ceased. The areas explored may be divided into four botanical regions:—(1) The coastal region, where the flora was largely of Malayan affinity. (2) The foot-hills, ranging from 500 to 3000 ft. elevation, an area of dense forest, the flora still typically Malayan but containing a distinct Australian element. (3) The frontal mountain belt from 3000 to 8000 ft. elevation, the begonia and balsam region. Here cultivation ceased. Palms disappear, and the first of the Palæarctic forms are met with, such as Viola, Ranunculus, Hypericum, and Galium. (4) The main mountain range. Here the big forest trees disappear, and herbaceous plants show a marked increase.—G. W. **Smith**: The genus Lernæodiscus, F. Müller, 1862.—Dr. J. C. **Willis**: A new natural order of flowering plants: Tristichaceæ, separated from Podostemaceæ.—Prof. C. **Chilton**: Some terrestrial Isopoda from New Zealand and Tasmania; with the description of a new genus, Notoniscus.—G. C. **Champion**: Curculionidæ from the Indian Ocean.

Geological Society, May 13.—Dr. A. Smith Woodward, president in the chair.—C. T. **Trechmann**: The Scandinavian drift of the Durham coast, and the general glaciology of South-East Durham. Evidence relating to the pre-Glacial levels and contours of the land in the Permian and Triassic areas has been collected and examined, and supports the conclusion that, immediately prior to the oncoming of glacial conditions, the land stood at not less than 100 feet above its present level. The fissures and depressions of the Middle and Upper Magnesian Limestones have been instrumental in preserving relics of the material brought by the earliest ice-sheet. This material proves to be devoid of the ordinary glacial erratics of the North of England and Scotland. The Scandinavian drift proper occurs about midway between Hartlepool and Seaham Harbour. It is represented by a transported shelly clay containing a fauna of Arctic affinities, which recalls that of some of the basement clays of Flamborough and Holderness. All the stones (between 300 and 400) found in this clay were collected and examined. The greater part are well-glaciated crystalline rocks, many of which (the typical Christiania eruptives) certainly are of South Norwegian origin. The apparent absence of any East Scandinavian rocks in Durham is noticed, and an explanation offered. Later than the fissure-filling material are certain water-deposited gravels and sands, which occupy shallow depressions underlying the main drift seen on the coast. The main drifts of S.E. Durham are described, and also the conspicuous kaimes developed about the village of Sheraton and others, associated with the Cheviot drift.—F. W. **Penny**: the Relationship of the Vredefort Granite to the Witwatersrand System. The Vredefort Granite has always been considered as a member of that "old granite" group, which everywhere in the Transvaal and in the Orange Free State is found emerging from beneath the Witwatersrand Series. Evidence is bought forward to prove the intrusive character of the Vredefort Granite, both into the Witwatersrand Beds and into the basic intrusion associated with them. Along its margin the granite has removed varying amounts of the sediments from point to point; it reacted with the basic intrusions in the sedimentary beds, with the consequent production of hybrid rocks. In one place, a subsidiary intrusion of granite occurs in the middle of the diabase. The granite, where it comes into contact with the slate members of the Witwatersrand Series, has induced definite metamorphism in them, producing a magnetite-actinolite-staurolite rock, which is of an entirely distinct type from that induced by the basic intrusion associated with the Witwatersrand Beds, a micaceous phyllitic rock. It is suggested that the Vredefort Granite, instead of being "Archæan," is of a post-Pretoria-pre-Karoo age, if not contemporaneous with, at least connected with, the same epoch of igneous activity as the "Red Granite" of the Northern Transvaal.

Royal Meteorological Society, May 20.—Mr. C. J. P. Cave, president, in the chair.—E. **Gold**: The reduction of barometer readings in absolute units, and a new form of barometer card. The Meteorological Office having now employed the c.g.s. units in its publications, this has necessitated the preparation of new tables for the reduction of the barometer readings and for the adjustment of the effect of difference between the standards of temperature 62° F. and 273° A.—A. Hampton **Brown**: A Cuban rain record and its application. The author dealt with the rainfall records of the Belen College Observatory, Havana, for the period 1859 to 1912, and gave particulars of the monthly, yearly, and seasonal rainfall. The average yearly rainfall for the fifty years 1861–1910 is just under 50 in., but during the past fifteen years there has been a marked tendency to diminished amounts. The rainfall year can be divided into two seasons: a wet from May to October, and a dry from November to April. During the former, 35·36 in., or 71 per cent. of the rain falls, the remaining 14·60 in., or 29 per cent., being recorded in the dry months. The author has endeavoured to trace the connection between the wet season at Havana during May to October, and the precipitation in England, south-west, and South Wales, during the three months, January to March following, and he has found that from 1878 onwards, when the first reports for this country are available, that an excess rainfall in Havana during May to October was generally followed by a deficient rainfall in England, south-west, at the beginning of the next year, and *vice versâ*. For the eight years 1888–95, when the rainfall at Havana was continuously in excess, in England, south-west, the figures with one exception were the reverse. During the next five years, 1896–1900, there was a deficiency at the Cuban station, and, excepting 1897, an excess in this country. There were many years where the application failed, but the general continuance of the see-saw movement was so persistent that it could scarcely be regarded as merely coincidental.

CAMBRIDGE.

Philosophical Society, May 4.—Dr. Shipley, president, in the chair.—W. L. **Balls**: (1) (*a*) A note on leaf-fall as a factor in soil-deterioration. Described two cases where soil was rendered infertile through the shedding of leaves from tree-cottons over several years, and by very heavy shedding from rank growth of ordinary cotton. (*b*) Specific salinity in the cell-sap of pure strains. Followed from investigating the salt relations of the previous note. Egyptian cotton was shown to be a facultative halophyte, and different pure strains of the same were found to differ in salt content when growing with interlacing root. (2) Predetermination of fluctuation. Environmental factors which act at, or near, the time when a character is manifest in an organism, are rarely of much importance in determining the development of that character. Such factors merely exercise a subsidiary deforming influence upon a predetermined scaffolding, which was constructed at a much earlier stage in the life of the organism. A conception of discontinuity is thus introduced into the study of fluctuation. Simple illustration is provided by the development of the cotton fibre. A most complex example is the flowering of the cotton plant.—J. T. **Saunders**: The ammonia content of the waters of small ponds. The free ammonia that exists in small ponds is very considerably reduced in amount after heavy rains, a reduction that is out of all proportion to the amount of rain that has entered the pond. This reduction in the ammonia content adversely affects the nannoplankton, which decreases after heavy rains.—F. A. **Potts**: (1) Thompsonia, a little-known Crustacean parasite. Thompsonia is a Rhizocephalan cirripede, characteristic of the Indo-Pacific area, parasitic on various Decapods. (2) The gall-forming crab, Hapalocarcinus. Hapalocarcinus causes the curious bodies known as "galls" on branching corals like Pocillopora and Seriatopora. The female alone is responsible for the gall building; growth of a coral branch is modified by her respiratory current. The male is less than one-sixth the size of the adult female, and apparently wanders from gall to gall.

BOOKS RECEIVED.

Zur Lehre von den Zuständen der Materie. By Prof. P. P. von Weimarn. Band i. Text. Pp. x+190. Band ii. Atlas. Tafel lii. (Dresden and Leipzig: T. Steinkopff.) 7 marks.

Annual Report of the Zoological Society of Scotland for the Year Ending March 31, 1914. Pp. 79. (Murrayfield, Midlothian.)

Department of the Interior. Weather Bureau. Annual Report of the Weather Bureau for the Year 1911. Pp. 166. (Manila.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., part 10. Pp. ii+291–312 +plates 85–88. Vol. iii., part i. Pp. 11+1–22+plates 89–92. (Sydney: W. P. Gullick.) 2*s*. 6*d*. each.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. xxxviii. Fasc. 1. Rapport du Président de la Société pour 1914. Les Cothurnidés Muscicoles. By E. Penard. Pp. 66+5 plates. (Genève: Georg et Cie.) 7 francs.

My Garden in Summer. By E. A. Bowles. Pp. viii+316+plates. (London and Edinburgh: T. C. and E. C. Jack.) 5*s*. net.

Notes on Elementary Inorganic Chemistry. By F. H. Jeffery. Pp. 55. (Cambridge University Press.) 2s. 6d. net.

Plants and Their Uses. By F. L. Sargent. Pp. x+610. (London: Constable and Co., Ltd.) 5s. net.

The Wonders of Wireless Telegraphy. By Prof. J. A. Fleming. Second edition, revised. Pp. xi+280. (London: S.P.C.K.) 3s. 6d. net.

Molecular Physics. By J. A. Crowther. Pp. viii+167. (London: J. and A. Churchill.) 3s. 6d. net.

Makers of Modern Agriculture. By Dr. W. Macdonald. Pp. ix+82. (London: Macmillan and Co., Ltd.) 2s. 6d. net.

Coast Sand Dunes, Sand Spits and Sand Wastes. By G. O. Case. Pp. 162. (London: St. Bride's Press, Ltd.) 5s. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 76 and 77, 78. (Jena: G. Fischer.) Each 2.50 marks.

Lunar Nomenclature Committee of the International Association of Academies. Collated List of Lunar Formations Named or Lettered on the Maps of Neison, Schmidt, and Mädler. Compiled and Annotated for the Committee by M. A. Blagg, under the direction of the late S. A. Saunder. Pp. viii+182. (Edinburgh: Neill and Co., Ltd.)

A Manual of Practical Physical Chemistry. By Dr. F. W. Gray. Pp. xvi+211. (London: Macmillan and Co., Ltd.) 4s. 6d.

The Naturalist at the Sea-Shore. By R. Elmhirst. Pp. viii+86+plates. (London: A. and C. Black.) 1s. 6d. net.

Das Herzflimmern seine Enstehung und Beziehung zu den Herznerven. By D. L. Haberlandt. Pp. 13. (Jena: G. Fischer.) 50 pfennigs.

Die Erregungsleitung im Wirbeltierherzen. By Prof. E. Mangold. Pp. 36. (Jena: G. Fischer.) 1.20 marks.

Board of Education. Special Reports on Educational Subjects. Vol. xxviii. School and Employment in the United States. Pp. iv+225. (London: H.M.S.O.; Wyman and Sons, Ltd.) 1s. 6d.

The British Revolution. By Dr. R. A. P. Hill. Pp. xii+116. (Cambridge University Press.) 2s. net.

Elementary Logic. By A. Sidgwick. Pp. x+250. (Cambridge University Press.) 3s. 6d. net.

John Napier and the Invention of Logarithms, 1614. By Prof. E. W. Hobson. Pp. 48. (Cambridge University Press.) 1s. 6d. net.

Cambridge Tracts in Mathematics and Mathematical Physics. No. 15. Complex Integration and Cauchy's Theorem. By G. N. Watson. Pp. 79. (Cambridge University Press.) 3s. net.

Ancient and Medieval Art. By M. H. Bulley. Pp. xxx+328+plates xxvi. (London: Methuen and Co., Ltd.) 5s. net.

A Manual of X-Ray Technic. By Capt. A. C. Christie. Pp. viii+104. (Philadelphia and London: J. B. Lippincott Co.) 8s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, May 28.

Royal Society, at 4.30.—Anomalous Trichromatic Colour Vision: Prof. W. Watson.—Formaldehyde Perhydrol: Dr. H. J. H. Fenton.—Studies of the Processes Operative in Solutions. XXIX.: The Disturbance of the Equilibrium in Solutions by "Strong" and "Weak" Interfering Agents: Prof. H. E. Armstrong and E. E. Walker.—A Type reading Optophone: Dr. E. E. Fournier d'Albe.—An Application of Electrolytically-produced Luminosity, forming a Step towards Telectroscopy: L. H. Walter.—The Axial Chromatic Aberration of the Human Eye: P. G. Nutting.—The Convection of Heat from Small Cylinders in a Stream of Fluid and the Determination of the Convection Constants of Small Platinum Wires, with Applications to Hot-wire Anemometry: L. V. King.

Royal Institution, at 3.—Identity of Laws: in General: and Biological Chemistry: Prof. Svante Arrhenius.

Concrete Institute, at 4.30.—Annual General Meeting.

Royal Anthropological Institute, at 8.15.—The Tribes of Togoland: Major H. Schomburgk.

FRIDAY, May 29.

Royal Institution, at 3.—Plant Autographs and their Revelations: Prof J. C. Bose.

SATURDAY, May 30.

Royal Institution, at 3.—Fiords and their Origin. II.: Fiords and Earth Movements: Prof. J. W. Gregory.

TUESDAY, June 2.

Royal Institution, at 3.—Celestial Spectroscopy: Prof. A. Fowler.

WEDNESDAY, June 3.

Society of Public Analysts, at 8.—The Insoluble Bromide value of Oils and its Determination: A. Gemmell.—The Determination of Iridium in Platinum-Iridium Alloys: C. O. Bannister.—(1) The Symbolical Representation of Analytical Operations; (2) The Properties of some Chlorhydrocarbons and their Uses in Chemical Analysis. II.: L. Gowing-Scopes.—The Changes in the Character of Fats during the Process of Cooking: Helen Masters and H. Ll. Smith.—The Chief Source of the Loss of Sulphuric Anhydride and of Chlorine by Ashing Substances containing these Constituents: J. O'Sullivan.

Entomological Society, at 8.

THURSDAY, June 4.

Royal Institution, at 3.—Faraday and the Foundations of Electrical Engineering: Prof. S. P. Thompson.

FRIDAY, June 5.

Royal Institution, at 9.—X-rays and Crystalline Structure: Prof. W. H. Bragg.

Geologists' Association, at 8.—Prehistoric Problems in Geology: R. A. Smith.

SATURDAY, June 6.

Royal Institution, at 3.—Studies on Expression in Art. I.: Origin and Development: Sigismund Goetze.

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THURSDAY, JUNE 4, 1914.

MEDIEVAL TECHNOLOGY.

The Art of Dying. In two parts. Pp. 356. (Stratford-on-Avon: The Tapestry Studio, n.d.) Price 3*s*. 6*d*. net.

THIS is not a medical or theological disquisition on the most desirable route to Valhalla, but a reprint, in the original spelling, of a book first published in 1705, on the methods then in vogue for colouring textile materials.

It was written for the instruction "of the lovers of the Noble Art of Dying," and the "Ingenious Reader" is informed that the anonymous author was a "Jealous Votary to Physical and Experimental Knowledge" who "purchased the Receipts at a very dear Rate." By means of the book "the Candid Peruser is cheaply obliged with the Select Practical Secrets of several Nations."

In all probability the receipts here collected really represent the best practice of the times, but they now appear very quaint, and a large number of the ingredients were obviously useless. For example, a black on silk was dyed in a vat containing no fewer than twenty-one ingredients, including senna, gentian, marjoram, honey, brandy, antimony, silver, gold, verdigris, copperas, and locksmith's filings. On the other hand (p. 93), "The manner of making a Fatt and preparing hot Suds to dye Woolen blew" gives a description of setting an indigo vat, which would almost stand good for a fermentation vat of the present day.

The second part of the book gives "A Perfect Description of Pot and Weed Ashes," with instructions "how to chuse the best sorts." In this portion there is some very quaint information for the "lovers of Mathematicks" and others: *e.g.* "Take two Fatts, take them to Pieces and of the Planks make one Fatt and it will be found to make four of the other Fatts" (in capacity).

Shipwreck of the vessels in which barrels of ashes were imported was evidently a common experience, as the art of fishing up the barrels with poles made for the purpose is fully described. Possibly, however, the poles were to be borrowed from the smugglers who had frequent occasion to use them for the purpose of recovering the casks of brandy sunk on the approach of the preventive men.

The recrudescence of handcrafts is due to a healthy revolt from present-day industrial conditions and results, but nothing would really be gained, either from the artistic or the economic point of view, by reverting to the old natural colouring matters. As well might we go back to burnt swallows or desiccated snakes for our medicines. The old-world charm of the stage-coach should not prevent us from making use of the convenience of the motor car, and a refusal to make use of modern scientific products would be an unnecessary limitation of the artistic possibilities of hand-made fabrics or other materials.

The book is, however, an interesting historical record.

WALTER M. GARDNER.

TAXONOMIC ZOOLOGY.

(1) *Catalogue of the British Species of Pisidium (Recent and Fossil) in the Collections of the British Museum (Natural History).* With Notes on those of Western Europe. By B. B. Woodward. Pp. ix + 144 + xxx plates. (London: British Museum (Natural History); Longmans, Green and Co., 1913.) Price 10*s*. 6*d*.

(2) *The Coleoptera of the British Islands.* By Dr. W. Warde Fowler and H. St. J. Donisthorpe. Pp. xiii + 351 + plates. Vol. vi. (Supplement). (London: Lovell Reeve and Co., Ltd., 1913.) Price 18*s*. net.

(3) *A Revision of the Ichneumonidae.* Based on the Collection in the British Museum (Natural History). Part ii., Tribes Rhyssides, Echthromorphides, Anomalides and Paniscides. By Claude Morley. Pp. x + 140. (London: British Museum (Natural History); Longmans, Green and Co., Ltd., 1913.) Price 5*s*. 6*d*.

(4) *Catalogue of the Heads and Horns of Indian Big Game. Bequeathed by A. O. Hume, C.B., to the British Museum (Natural History).* By R. Lydekker. Pp. xvi + 45. (London: British Museum (Natural History); Longmans, Green and Co., Ltd., 1913.) Price 2*s*.

(5) *The Fauna of British India.* Including Ceylon and Burma. Hymenoptera Vol. iii., Ichneumonidæ: 1. Ichneumones Deltoidei. By Claude Morley. Pp. xxxvi + 531. (London: Taylor and Francis, 1913.) Price 20*s*.

(6) *Catalogue of the Lepidoptera Phalaenae in the British Museum.* Vol. xiii. By Sir George F. Hampson, Bart. Pp. xiv + 609 + xviii plates. (London: British Museum (Natural History); Longmans, Green and Co., Ltd., 1913.) Price 16*s*.

(1) THIS excellent monograph deserves a niche to itself; not, indeed, because of the inherent splendour of its raw material, for it embodies only the exuviæ of a few species of small fresh-water Mollusca, but by reason of its form, its style, and its finished technique. Its quality and dignity are enhanced by the fact that it takes in not only the present condition and past history

of the genus Pisidium, but also the geological relations of the British species.

All taxonomic work on fresh-water Mollusca—perhaps all taxonomy of fresh-water invertebrates—is difficult, even when no obfuscation has accrued from the fitful labours of commentators, because of the infinite little diversities of environment to which fresh-water species are exposed; but the genus Pisidium offers peculiar difficulties, on account of the small size of the shells and the obscurity of their specific features.

There can be little doubt that this fine monograph, with its critical treatment of history and synonomy, its concentrated attention upon crucial hinge characters, its graphic summaries of specific distribution, its exhaustive bibliography, and its copious wealth of figures, will make the way easy for students of the British species of the genus Pisidium. But it is doubtful whether any but an experienced veteran will appreciate the immense labour and unwearied application which this work, involving close examination of many thousands of specimens, recent and fossil, represents.

(2) The sixth volume of this important and useful work consists partly of concise descriptions—accompanied by exact records of distribution—of species added to the British list since the publication of the fifth volume in 1891, and partly of miscellaneous notes and records compiled by Mr. Donisthorpe. There is an interesting introductory chapter by the senior author, in which classification and some other matters of general interest are discussed. For classification he repeats his division of the Coleoptera into three suborders: Adephaga, Polycerata, and Lamellicornia, the Polycerata including the Staphylinoidea and five big groups (Clavicornia, Serricornia, Heteromera, Phytophaga, and Rhynchophora), which some entomologists still regard as suborders.

The species question is briefly alluded to in a few very sensible words, Dr. Fowler apparently not being addicted to the belief that species are entities that sprout into existence ready-made.

(3) In this volume the four tribes Rhyssides, Echthromorphides, Anomalides, and Paniscides are reviewed, the first two tribes being briefly characterised and the last tribe being fully defined, while the limits of the third (Anomalides) are merely indicated by the constituent genera. There are 298 species included, and these are distributed in 30 genera, 71 of the species and 8 of the genera being named and defined as new to knowledge. All the genera and species are differentiated in neat and concise, yet adequate, tables; and beyond this the limits of each genus are critically discussed, and in the case of species the synonomy and geographical distribution, and usually the salient specific attributes, are fully considered. It is a model of a revision, and the only word that can be breathed against it is that in the geographical grouping of the species of the larger genera political instead of zoological divisions of the globe are adopted—which is rather a pity, as the geographical distribution of many of the genera is very suggestive, and deserves to be emphasised. It is to be hoped that in taking this course the author has not been influenced by those extremists of the convergence school who try to flout the systematist out of his calling.

(4) A portrait and an appreciative biographical sketch of the original of this bequest—a man distinguished alike for his ardour in natural history and sport, his culture, and his generosity—take this small volume quite out of the roll of common museum catalogues.

The material catalogued includes ninety-seven picked specimens of Indian big game trophies, making a collection such as, to quote Mr. Lydekker, "it would nowadays be impossible to bring together." Every specimen is meted and appraised acording to mode. No fewer than twenty-four of them have a place in the front rank, four of these—to wit, of the Shou (*Cervus wallichi*), the Tibetan Antelope, the Himalayan Serow, and the Lahul Ibex—being "records"; while eight more—namely, of the Yak, the Bharal, the Sind Wild Goat, the Nilgri Tahr, the Blackbuck, the Yarkand Gazelle, the Yarkand Stag, and the Chital—are, severally, *proxime accesserunt*.

Modest as are its limits, the work bears the author's hall-mark.

(5) This volume, dealing with a group of insects of approved economic value, is a noteworthy addition to the fauna of British India. But if it satisfies expectations it excites them no less, since, though all the great component parts of the Ichneumon family are defined and correlated, it is only an instalment in which about half the known specific forms are arranged and described.

The author's preface, wherein he quotes with full appreciation the saying of Agassiz, that "the purpose of systematic work must be to increase our knowledge of the relationship of animals," at once inspires confidence. This confidence is strengthened by the judicious management and scholarly tone of the introductory chapter, in which a historic account of the family is followed by sections, as clear as they are concise, treating of metamorphosis, structure, and classification. After this, the author's statement that concise tabulation is very difficult, on account of the extraordinary instability of species in this family—an instability in which, among other contributing factors, cross-breeding may perhaps play a part—arouses little misgiving.

The definitions of genera, of which there are 140, and of species, of which there are 406, are polished, and can be read without fatigue, and conspicuous attributes and suggestive relations are effectively summarised. The text-figures illustrating genera are for the most part very clear and good.

(6) The construction of this monumental work goes steadily on, to the infinite honour of its author.

This thirteenth volume, of more than 600 pages, represents two subfamilies, and part of a third, of the great group Noctuidæ. The species included are of Catocalinæ 379, bringing up the total number for the subfamily to 1022, of Mominæ 74, and of Phytometrimæ 226.

The key to the Catocalinæ is reprinted from vol. xii., for convenience. This key, with its clear dichotomies for no fewer than 109 genera, as well as similar keys to the species of the larger genera, embracing some 26, some 40, and one even 101 species, enables the casual critic to form some idea of the prodigious amount of attentive labour embodied—one might almost say enshrined, when one considers that this is an ordered part of a monument *aere perennius, pyramidum altius*—in this volume.

The illustrations are on a generous scale; in addition to 455 beautiful coloured figures, in eighteen plates separately bound, there are 130 figures in the text, so that every genus is represented at least once.

SIX ESSAYS ON SEX.

(1) *Ursprung der Geschlechtsunterschiede.* By Dr. Paul Kammerer, in Fortschritte der Naturwissenschaftlichen Forschung. Herausgegeben von Prof. Emil Abderhalden. Bd. V., pp. 1–240. (Berlin and Vienna, Urban and Schwarzenberg, 1912.) Price 15 marks.

(2) *Die biologischen Grundlagen der sekundären Geschlechtscharaktere.* By Dr. J. Tandler and Dr. S. Grosz. Pp. 169. (Berlin: Julius Springer, 1913.) Price 8 marks.

(3) *Sex Antagonism.* By Walter Heape. Pp. 217. (London: Constable and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(4) *The Nature and Origin of Secondary Sex Characters.* By F. W. Ash. Trans. North Staffordshire Field Club. xlvii. (1913), pp. 79–93.

(5) *Les Problèmes de la Sexualité.* By Prof. Maurice Caullery. Pp. 332. (Paris: Ernest Flammarion, 1913.) Price 3.50 francs.

(6) *Heredity and Sex.* By Prof. T. H. Morgan. Pp. ix+282. (New York: Columbia University Press; London: Oxford University Press, 1913.) Price 7*s.* 6*d.* net.

(1) DR. KAMMERER has made all students of the biology of sex his debtors by taking a scholarly and critical survey of most of the recent contributions to the subject, and of the experimental work in particular. His treatise is a model of fairness and thoroughness, and must have involved a prodigious industry. He deals with the determination of sex, the theories of sex dimorphism, the results of experiments in castration, regeneration, transplantation, breeding, and environmental influence, and at very considerable length with the recent work on the internal secretions of the reproductive organs. The bibliography occupies twenty-three pages of small type! An attempt may be made to indicate Kammerer's general conclusions. The first important step in the evolution of sexual reproduction was the specialising of germ-cells as distinguished from body-cells. The second was the differentiation of macrogametes and microgametes, which are contrasted in their assimilation capacities, amount of cytoplasm, size, and activity. The factors that condition maleness ("mikrogametismus") or femaleness ("makrogametismus") are ultimately assimilation differences—the thesis, it may be recalled, of "The Evolution of Sex" (1889), to which no reference is made in text or bibliography. The differentiation of sex doubtless occurred very early in phylogeny, and the determination of sex occurs correspondingly early in ontogeny. During maturation the gametes are probably in varying degrees susceptible to environmental influence, so that their predisposition to one sex or the other may be changed, but the higher the animal the less is its susceptibility. Only in plants and in the lower animals can we now succeed in experimentally changing the progamic predisposition, activating the tendency which should otherwise remain latent.

Removal of the essential gonads changes the metabolism of the body, and is usually followed by a degeneration of the subsidiary sex characters. But it is practically impossible to draw a definite line between sex characters and body characters. It seems as though the body were "sexed" through and through. The castration, however early, never prevents the appearance of the embryonic primordium of any character; it merely exerts a quantitative influence on the development. When the essential gonadial substances are introduced by transplantation or injection into a castrated animal, the effects of castration are alleviated or reversed, and what can be done with ovarian substance can also be done with testicular substance. It is an extraordinary fact that injection of the gonadial substance, or even cerebral substance, of animals in heat (of males especially), may be followed in castrated animals by sexual excitement and symptoms of heat. The eroticised brain is to be regarded as a regulator, which quickens or retards the growth of certain parts by its effect on the blood-vessels, and also affects the tonus of other ganglia.

Kammerer goes on to show that sex characters behave in inheritance like specific or racial characters; they illustrate either blended or alternative inheritance. Indifferent systematic characters may come to be sex-linked; all sex characters are fundamentally species characters, and all species characters are also sex characters. As we shall point out later, this appears to us to be a sound idea exaggerated into an extravagance. Nor can we accept Kammerer's general Lamarckian theory, for which no convincing evidence is adduced, that sex differences have been environmentally impressed on the passive organism or functionally acquired by the active organism. Our only other criticism of a monumental piece of work is that the author seems to be just a little in a hurry to accept conclusions in regard to the efficacy of the gonadial hormones. Some of Mr. Geoffrey Smith's recent work, which is of the highest importance, seems to indicate that we are not shut up to one interpretation.

(2) The fine work of Tandler and Grosz is in many ways like Kammerer's, but it deals in the main with man and mammals. The authors regard the differentiation of dimorphic gametes as the first and fundamental step in the evolution of sex; somatic dimorphism was a later acquisition. The criterion of a sex character is not so much that it has to do with reproduction, but that it responds variably to the stimulus of the internal secretion of the gonads. Sex characters are not novelties, but specific, or generic, or other systematic characters which have been brought into close correlation with the glands of internal secretion, and with those of the gonads in particular. This thesis is supported by masterly argument, and one is not disinclined to admit that, not only in regard to sex characters, but also in regard to other adaptive characters, it has been the method of evolution to get apparently new things out of the most ancient materials. It will be remembered that Dohrn elaborated this idea in his theory of "Funktionswechsel." But it appears to us that Tandler and Grosz have over-generalised. It may be that the antlers of the stag are masculine exaggerations of a systematic character once common to both sexes (and still shared by both in the reindeer), but we think there are many cases, especially among invertebrates (where we know little of internal secretions), which will not admit of a similar interpretation. Is the pouch of the female marsupial, or the pouch of Nototrema, or the shell of the female Argonaut referable to a systematic character originally common to both sexes? The claspers of Selachians are evolved from portions of the pelvic fins, and to that extent from a character common to the two sexes; but is there any warrant for supposing that ancestral female Selachians had anything definitely corresponding to "claspers"? The same kind of remark may be made in reference to many similar cases, such as the extraordinarily specialised tips of the pedipalps in male spiders. And what shall we say of such familiar sex characters as the scrotum of most male mammals or the ovisacs of many female Copepods?

(3) Mr. Heape is well known as an embryologist and investigator of the physiology of reproduction, and his conclusions on the relations of the sexes are entitled to careful consideration. He is of opinion that the male sexual instincts and requirements are quite different from those of the female; environmental changes affect the two sexes differently; antagonism arises when the natural requirements of the two sexes clash. Thus he regards the present phase of the woman's movement ("the present sex war," he calls it) as primarily a biological phenomenon. "It is obvious that the driving force is engendered by desire to alter the laws which regulate the relations, and therefore the relative power of the sexes." At present the male is disturbed and damaged by being compelled to repress his strong generative impulse; the female is disturbed and damaged because she is leaving, or is forced to leave, the straight path of maternity. This seems to us an exaggeration of the sex factor, and we adhere to the belief that the driving force with the great majority of women interested in the wholesome unrest of to-day is the deliberate and conscious desire to alter those social, economic, and political conditions which have tended in the past to prevent large numbers of women from taking their due share in citizenship. We think that Mr. Heape has done good service in emphasising the deep constitutional differences between man and woman, and we heartily agree with his conclusion that "a woman's usefulness, her value in society, and therefore her power and her happiness, depend not on her likeness to, but on her dissimilarity from man." We maintain, however, that the threads of sex have been caught up and intertwined with so many others that, although the importance of no set of threads can be disregarded, the attempt

to refer this or that movement to purely physiological, or purely psychological, or purely economic factors is a false abstraction.

Of great interest and value, as it seems to us, is the author's contribution to the theory of exogamy and totemism. In a discussion with Dr. Frazer—a model expression of vigorous difference of opinion—Mr. Heape maintains that the origin of exogamy, the cause from which the habit arose, is to be looked for in "the natural desire of the male to seek for his mate outside his own family or clan; while totemism, in so far as it is a more or less elaborate system of restricting the wanderings of the errant male, was probably derived from the opposite sex." To the male the sexual gratification is of more moment; the strange woman is more stimulating; hence exogamy. To the female the consequences of sexual consummation are of more moment; she is at heart a mother with a family; hence totemism, a product of the feminine imagination, which has aided enormously in the consolidation of the family. According to Dr. Frazer, it was in ignorance of the physical significance of paternity that the primitive mother explained to herself the quickening of the child in her womb as due to the entrance of a child-spirit from some external object—a tree or fruit, a beast or bird—the totem. Mr. Heape points out the difficulties in the way of accepting this theory, and especially the difficulty of believing in a primitive ignorance of the part the male plays in generation. He suggests that the superstition was the outcome of the pregnant mother's desire, hope, and finally belief that the virtue of something she admired in the outer world might pass into her child and endow it. This is, of course, the merest indication of the author's thesis, which is admirably defended.

(4) Mr. F. W. Ash propounds the view that male secondary characters are, in general, characters of "abandoned function," corresponding to parts which were functional and developed in both sexes in the comparatively recent ancestry; they develop in the adult male because there is nutritive material to spare, they do not develop in the female because "the surplus growth energy is more directly diverted to provide for a fresh generation." The first part of this theory corresponds to the view of Tandler, Grosz, and Kammerer, that sex characters are derived from systematic characters once common to both sexes; the second part of the theory corresponds to the much-discussed "surplusage theory" of Hesse and Doflein. Towards the end of his paper the author maintains that the differences between the sexes depend on differences in nutrition—which favour anabolic or katabolic preponderance—an interpretation argued for by the authors of "The Evolution of Sex" (1889), and recently rehabilitated by others.

(5) If one wishes a descriptive account of the facts of sex, brought well up to date, one has it in Prof. Caullery's volume. He discusses the gametes, hermaphroditism, sex dimorphism, sexual selection, castration, internal secretions, the determination of sex, Mendelism and sex, parthenogenesis, sex and asexual multiplication, sex in plants, and sex in the simplest organisms. We are not impressed with the arrangement of the book (the author has his own views on this subject), but we are impressed with its clearness, carefulness, and scepticism. It almost overdoes objectivity, and we are not left with an evolutionist picture—probably because the author thinks the times are not ripe. He is convinced, however, that sex is an aspect of the whole organism—dependent primarily, though not always finally, on the physico-chemical constitution of the fertilised ovum; and he leaves us with the conundrum: Does the germ determine the sex of the soma, or does the sex of the soma determine the differentiation of the germ? The answer is that the question is wrongly put.

(6) Prof. T. H. Morgan seeks to link together the results of experimental and cytological analysis. Some of his general positions may be summed up:—Sexual reproduction has been utilised in evolution in the building up of new combinations, but it does not furnish materials for progressive advance; sex determination depends on an internal mechanism, which appears to be the same as that which regulates the distribution of Mendelian characters; sex is due, like any other character, to some factor or determiner contained in the sex chromosomes, of such a kind that when present in duplex it turns the scale so that a female organism results, and that when present in simplex, a male results; sex-linked characters, while following Mendel's principle of segregation, are also undeniably associated with the mechanism of sex—that is, with the behaviour of the chromosomes at the time of the formation of the germ-cells; Darwin's theory of sexual selection is open to serious criticism, for there is no clear proof of choice, and there is lack of evidence that selection could effect the sex differences, which may be due to mutations; the secondary sex characters are not all on the same footing (in insects, for instance, their development is independent of the reproductive organs), and it is not likely that their evolution can be explained by any one theory. The author also deals with gynandromorphism, hermaphroditism, and special cases of sex inheritance; and one of the most valuable chapters in

the book is a discussion of fertility and sterility in the light of recent advances. We have to thank Prof. Morgan for these lucid and scholarly lectures on heredity and sex, which express his characteristic combination of critical judgment and synthetic appreciation. The reader is assisted by the numerous illustrations, many of which are very fresh and interesting. J. A. T.

OUR BOOKSHELF.

Das Elisabeth Linné-Phänomen (sogenanntes Blitzen der Blüten) und seine Deutungen. By Prof. F. A. W. Thomas. Pp. 53. (Jena: G. Fischer, 1914.) Price 1.50 marks.

This small work has the two-fold object of directing the attention of nature-lovers to the pleasing phenomenon of "Flashing Flowers," which is more exactly defined as the Elizabeth Linnæus Phenomenon, and of giving a scientific explanation of its cause.

Perhaps the most interesting feature of the investigation is the names with which it is associated, beginning with Elizabeth Linnæus (daughter of the great Swedish botanist), who first observed the flashing of Indian Cress flowers at twilight in her father's garden at Hammarby, near Uppsala, and published her observation with a comment from Linnæus himself. Her discovery interested a number of scientific men, who ascribed the appearance to electricity, phosphorescence, etc., or rejected it as imaginary and only visible to those who could see ghosts. High above them all stands Goethe, who answered Elizabeth Linnæus's pertinent question "whether the flashing is in the flower or in the eye," by referring to the effect upon the eye of brilliant complementary colours, and by pointing out that the flashing is only seen in a flower which comes sideways into the field of vision.

Prof. Thomas gives an explanation of the phenomenon. It is perceived, he says, in twilight, which makes red brighter and green duller than they appear in full daylight. As the image of the red flower moves from the peripheral part of the retina, where the rods are red-blind, to the fovea, the red is perceived somewhat more vividly than before, and this image coincides with the Purkinje after-image of the surroundings, giving the impression of a flash. H. W.

Die Wichtigsten Lagerstätten der "Nichterze." By Prof. O. Stutzer. Zweiter Teil: Kohle (Allgemeine Kohlengeologie). Pp. xvi+345+xxix plates. (Berlin: Gebrüder Borntraeger, 1914.) Price 16 marks.

This second part of Dr. Stutzer's encyclopædic work is entirely devoted to coal and other carbonaceous deposits. The first, or petrographical, division of the volume deals with the chemical and physical characters of coal and the results of its microscopical examination, with a discussion of the theories of the origin of coal. The aim of the author is to bring together the observations and conclusions of all who have written upon the subject, rather than to advocate any particular views of his own. The second division of the work is stratigraphical, and an immense amount of valuable information is collected and classified concerning coal-seams—their modes of occurrence and the indications which they exhibit of operations taking place during and subsequently to their deposition. The third division of the book is statistical, dealing with coal-supply and coal-production in all parts of the globe, full use being made of the important work on "The Coal Resources of the World," which was inaugurated at the meeting of the Geological Congress at Toronto and published last year. Throughout the work before us no effort seems to have been spared by its author in making the information complete and up-to-date. Among the numerous wood-cuts are given many graphic illustrations, which are of the greatest assistance to the reader, as well as copies of figures derived from the works of a great number of different authors. Taken altogether, this second part of Dr. Stutzer's monograph fully realises the high expectations which must have been formed by all who have used his earlier volume.

Descriptive Geometry. Part i., Lines and Planes. By Prof. John C. Tracey. Part ii., Solids. By Prof. H. B. North and Prof. J. C. Tracey. Pp. x+126. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 8*s.* 6*d.* net.

Perhaps the most notable feature of this work is its logical development of the subject. Beginning with the point in space we are shown its plan, front elevation, and side elevation, when situated in the various positions relatively to the three planes of projection. Then follows an equally exhaustive treatment of the line and plane. A very complete system of notation, specially suitable for oral instruction as well as for private reading, is carefully defined and strictly adhered to throughout. Also, in the authors' scheme is a unique system of triple columns. In the first column the problem is stated in general terms along with the principles and previous problems involved. In the other two parallel columns we have an illustrative particular case, accompanied by a figure, or by a series of figures exhibiting the successive steps in the solution. The authors give special prominence to three fundamental constructions on which most of the subsequent work is based.

A student who has thoroughly mastered the first part of the book should have little difficulty with the second, which deals with some of the simpler geometrical solids; their projections when situated in easy and in difficult positions; their sections by vertical, inclined, and oblique planes; the development and intersection of their surfaces; and the determination of lines and planes tangential to them.

The general treatment is purposely somewhat abstract, being unrelieved by practical problems or applications. The authors, however, propose to issue later a complete set of exercises for use with this very thorough and sound work on descriptive geometry.

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.*]

Efficiency of Damped Seismographs.

IN NATURE (April 2, 1914, p. 119) I found reprinted a statement of Dr. Cavasino, concerning the influence of damping on recording seismographs, which I think is based upon a misunderstanding.

There is no doubt that when damping is introduced, until the limit of aperiodicity is attained, the proper period of the instrument exists as such. But it is not that point at all which is important, but the fact that more or less heavy damping diminishes the influence of the proper motion of the instrument on the record and enables one to obtain a much more trustworthy picture of the true motion of the ground.

Further, if you have an instrument of low sensitiveness and simply introduce a heavy damping you will make a very bad seismograph; but nobody proceeds in this way. When damping is introduced, one must simultaneously provide to augment the magnification, be it by introducing magnifying levers like those in Wiechert's instruments, or by using galvanometric registration as in the aperiodic seismographs. The lengthening of the proper period of the instrument also gives good results for the longer seismic waves.

If these precautions are taken, heavily damped instruments give absolutely the same moments for the commencement of both first preliminary phases of an earthquake as undamped ones; moreover, the three different components give absolutely the same results. There can be no question of a difference of several minutes, not even of seconds, as Cavasino states. The difference in the times of arrival of the first longitudinal waves for the aperiodic instruments of the Pulkovo seismological station for the three components of the movement of the ground differ from another only by a fraction of a second.

Cavasino's assertion, that damped pendulums give fewer records of earthquakes than undamped ones only depends upon the way in which the damping is introduced, and as a general statement does not hold good. In fact, the *aperiodic* instruments in Pulkovo registered in 1912, 671, and in 1913, 576 earthquakes; the number of azimuths of the epicentre determined at Pulkovo were, in 1912, 137, and in 1913, 103.

In 1913 the number of earthquakes registered by aperiodic instruments were: In Tiflis, 456; Irkutsk, 738; and Taschkent, 954.

I doubt whether any other seismological station using undamped seismographs has approached these figures.

B. GALITZIN.

Laboratoire de Physique de l'Académie
Impériale des Sciences, St. Pétersbourg,
May 11.

Spectra of Secondary X-Rays.

HITHERTO all X-ray spectra have been obtained by using the body, the spectrum of which is to be examined, as an antikathode inside the tube. All the trouble of exhausting the tube, etc., can be avoided by illuminating the substance of which the spectrum is to be determined with the primary rays from a tube of any of the usual types, and only allowing the secondary rays to enter the spectrograph. I have photographed the secondary spectra of copper, zinc, mercury (amalgam of zinc), etc., by this method without any trouble. Zinc amalgam, for instance, shows five rays, two due to zinc, one due to some impurity—probably iron—and two due to mercury.

If a quantity of the substance to be examined is placed in a thin paper bag, the experiment is particularly striking. Using zinc oxide, for instance, the presence of zinc was evident immediately, so that the chemical analysis of a substance inside a closed envelope without in any way touching or manipulating it is no longer beyond the bounds of possibility.

The method promises to be particularly useful for any experiment in which the rays emitted under various conditions are to be examined, such as those on the effect of an electric or magnetic field upon the spectra, with which I am now engaged.

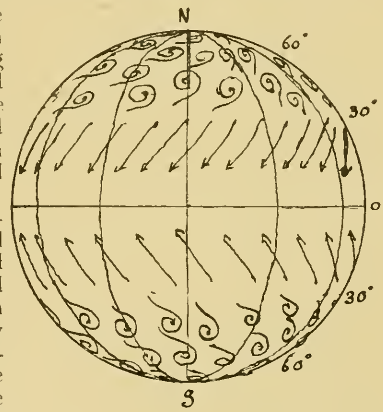
MAURICE DE BROGLIE.

29 Rue Chateaubriand, Paris, May 30.

Weather Forecasts.

AT the conclusion of my former note on this subject (NATURE, February 26, 1914, vol. xcii., p. 711) I said that it seemed improbable that trustworthy forecasts of the weather for twenty-four hours in advance ever would, or could, be made for latitudes far removed from the equator, and in the present communication I give the reasons for that opinion.

Enough is now known concerning the average weather conditions on the globe to show that were it possible to make the surface wind currents visible and to observe their distribution from a distance, the appearance would be very much like that given in the accompanying figure, provided that the surface was level and uniform in quality, *i.e.* all land or all sea.



The wind currents on the actual earth if viewed in this way would no doubt be seen to be considerably affected by differences in the nature of the surface over which they passed, more particularly where that surface was mountainous, but the general character of the flow would still be that given in the figure, namely, that round the equator (leaving seasonal variations out of account), there would be a region of calms bordered on each side by fairly regular trade winds extending roughly to latitude 30° N. and S.; whilst outside this region again, the whole surface would be covered by eddies of various sizes in which the direction of circulation was left-handed in the northern, and right-handed in the southern hemisphere.

If pressure could be observed, as well as the direction of the wind, the central parts of the eddies would always appear as regions of low barometer. Were the observations extended over a few hours, it would be seen that the eddies themselves (*i.e.* their centres) were in motion travelling on the whole to the N.E. and S.E. in the northern and southern hemispheres respectively.

Continuing the observations for days or weeks, it would be found that the eddies were mostly short-lived, few lasting more than two or three days, and that although their average course was N.E. or S.E., as stated above, yet individuals among them moved in different directions and with very different speeds.

It would be found also that the variations from the mean with respect to the duration of each eddy, the path of the centre, and the intensity of the circulation about it, were matters of chance; so that the ordinary laws of chance might be applied to determine the probability that in a given place and for a given time the departure from the mean should lie within assigned limits.

Experience over the temperate and polar regions of the world has proved that on the whole certain types of weather are associated with certain surface winds, although the particular relation of each to the other may vary in different places.

In order, therefore, accurately to predict the weather, it is a matter of foremost importance to know what the direction and character of the wind will be at the time and place for which the prediction is issued.

This, however, requires not only a knowledge of the surrounding conditions at the time of issue, but also of the rate at which the conditions are changing, and, since the rate follows no known law, predictions cannot be held to be trustworthy for more than the short time during which the rate may be considered to be constant or to change uniformly.

How long this "short time" may be when reckoned in hours or days varies with the type of eddy or pressure disturbance. When the depressions are large and deep they may retain their life for several days or even more, and in such cases their rate of change may remain regular for a considerable fraction of that time.

It is in these comparatively rare conditions that the best forecasts can be made. Ordinary weather, however, is the accompaniment of shallow depressions of small intensity and short duration, the regularity of the path and rate of change of which cannot be counted on for more than a few hours. In such circumstances any forecast made for a day in advance is almost as likely to be wrong as right, and since the shallow depressions are chief occupants of the temperate and polar regions it seems that even the most complete knowledge of their present state and previous history gives very little information as to what their condition will be even a few hours later.

This leads to the conclusion given in the previous note, namely, that the information furnished by daily weather charts gives a small, but only a small, advantage in favour of forecasts made on the strength of it over the simple guess that the weather will remain as it is.

In some places, though not in England or its immediate surroundings, the diurnal variations are more important than the general pressure distribution, and in mountainous regions impending weather changes can often be foreseen from the behaviour of clouds about the hills.

Success, however, in such cases depends essentially on local experience and not on general knowledge.

A. Mallock.

The Plumage Bill.

My attention has been directed to an article in Nature of December 11, 1913 (No. 2302, vol. xcii.), entitled "The Plumage Bill," by Sir H. H. Johnston, in which the following statements are made regarding the destruction of bird-life in Nipal:—

(1) "Originally the Nipalese respected almost religiously the fauna of their native land, like most Indian peoples. But of late they have become infected with a truly British love of life destruction. They are incited to this by the agents of the plumage trade in Calcutta and other places, and, of course, find it a lucrative business."

(2) Nipal . . . "is permitted to import and export goods through British India under its own Customs' seals, intact and unquestioned.

"Consequently, though the laws of British India forbid on paper the export of wild birds' plumes or skins, the State of Nipal monthly exports from Calcutta to the feather markets of the world—principally London—thousands of bird skins. The Nipalese have nearly exterminated the Monal pheasant, the Tragopan, and several other gallinaceous marvels."

In replying to the above extracts from the article in question I am concerned mainly with the implication that the Nipal Government, to which I am and have for the last eight years been the accredited British Representative, are concerned with the destruction of bird-life for trade purposes, and are, in fact, the principals in the trade of bird feathers and skins.

Neither the Nipal Government nor any of its officials is privileged to export goods through British India under the Customs' seals of the State, and any traffic in bird feathers and skins such as is described in the article, if it is being carried on at all, must necessarily be done in contravention of the British Indian Customs Regulations, as no exceptions are made in favour of Nipal goods passing through our ports.

The Prime Minister in Nipal, who has seen and read the article, has authorised me to state explicitly that the Nipal Durbar have no interest whatever in the export of feathers from Nipal, and that such export is contrary to the laws of the State.

As regards extract No. (1), it is doubtless true that in old days there were fewer birds and animals destroyed in the country than at present. Originally the religion of the ruling race in the Nipal Valley and of a considerable part of what is now the modern State of Nipal was Buddhism, in which life is held sacred; whereas now the prevailing religion is Hindu "Shivaism," and the worship of Durga. Old-fashioned bows and arrows have also given way to firearms, while the sporting instinct of the Gurkha has in no way lessened with the improvement of the weapons at his disposal.

My own observation, however, in the hills surrounding the Nipal Valley does not confirm the very wide statement that the Monal pheasant, the Tragopan, and other gallinaceous marvels of this secluded country are in any danger of extinction at present.

J. Manners-Smith.

The Residency, Nipal.

My statements as to the destruction of rare pheasants in the kingdom of Nipal were based, first, on facts which came to my notice when on or near the frontiers of Nipal in 1895, but a good deal more on the recent allegations made in the Calcutta Press, on the reports of an American ornithologist, and on other matter published in the pamphlets of Mr. James Buckland, or read by him at his public lectures. Much of this evidence was before me when the articles (to which Lieut.-Col. Manners-Smith takes exception) were written. But as it is difficult for one who writes a good deal and on many subjects (and has, moreover, in the months that have elapsed been undergoing the inconvenience of alterations to his writing-room) to keep such evidence so that it can remain always at his right hand, I have preferred to take the course of writing to all the persons who furnished these original accounts, asking them to instruct me once again, or at any rate to give me references which can be followed up. As this necessitates writing to America and to India, as well as to persons in London, some weeks may elapse before I am able to answer the main points in Lieut.-Col. Manners-Smith's letter.

I would, however, inform Lieut.-Col. Manners-Smith that Mr. James Buckland, who had collected all or much of such evidence affecting the Government of Nipal, sought to lay this before his Highness the Prime Minister of that country, when Maharaja Sir Chandra Shamsher Jang visited this country not long ago, but Mr. Buckland was not accorded an interview and not permitted to submit, with all due respect, the case of the rare birds of Nipal, either to the Maharaja or to his English advisers.

I am sincerely glad that any article of mine should have directed the attention of the Government and British Resident of Nipal to the preservation of the Nipalese avifauna, even though that Government may have already dealt effectively with the question. This large independent Himalayan State contains within its limits some of the most wonderful birds in the world, none of which are in any degree whatever harmful to man, and most of which are of exceptional interest and beauty. The whole of the fauna of Nipal stands out as being perhaps the most remarkable of any Asiatic State. The independence of Nipal is scrupulously respected by the British Government, the country is not thrown open to access on the part of foreigners, and it might well be the national ambition of the Nipalese Government that their land should become a refuge for the wonderful birds and mammals still existing in tropical Asia, which are rapidly being exterminated elsewhere. So soon as I have the information asked for, I will forward it for publication in the columns of NATURE.

H. H. JOHNSTON.

Atomic Volume Curves of the Elements.

IN his interesting review of Prof. Letts's book on "Some Fundamental Problems of Chemistry," in NATURE of May 21, Prof. Meldola states that an atomic volume curve which includes the inert elements is there published for the first time.

Will you allow me to say that in our book on "Systematic Inorganic Chemistry," first published in 1906, Dr. Lander and I included an atomic volume curve in which the inert elements were shown; and that in our 1911 edition the curve was amended to indicate the position of helium, then recently liquefied, so that lithium was seen no longer to occupy the crest of the first wave. I may add that in Kipping and Perkin's "Inorganic Chemistry" (1911) a curve similar to ours appears.

R. M. CAVEN.

University College, Nottingham, May 25.

I AM sorry inadvertently to have done an injustice to Drs. Caven and Lander, whose claim for priority over Dr. Letts for having constructed an atomic volume curve comprising the inert elements is certainly justified. At the time of writing the review I was remote from libraries, and I had an impression that the Letts curve had been published by its author long before its inclusion in the work noticed, in which it is referred to as the "new curve" (p. 63).

R. MELDOLA.

Transmission of Electric Waves Round the Bend of the Earth.

I BEG leave to amend a sentence in my letter which appeared in NATURE of May 28. I wrote that the existence of a most favourable wave-length for transmission to a given distance appeared to be contradicted by the diffraction theory. A more leisurely study of Prof. MacDonald's paper shows me that I have in this respect misinterpreted his integrals, and that it is not impossible that the existence of an optimum wave-length may yet be explained by his analysis. This emendation in no way affects the table of ratios I gave or the wording of the conclusion drawn therefrom.

W. ECCLES.

University of London, University College, June 1.

SCIENCE AND THE STATE.

AT a time when our Government is embarking on large schemes of social legislation at a heavy cost to the community, it seems a fitting opportunity to direct attention to one branch of the public service which has hitherto failed to obtain official recognition or financial support.

It is difficult to realise what our state of civilisation would have been were it not for scientific researches conducted mainly at their own expense by private individuals. The progress which has changed the conditions of our life from those prevailing in the so-called barbaric ages has been effected largely at the expense of a body of reformers who have sacrificed their own prosperity for the benefit of the community in a way which no modern Cabinet Minister would dream of doing, and who have been rewarded for their enthusiasm by neglect and discouragement.

The position of these workers has been ably put forward in the article on "Sweating the Scientist," which appeared in *Science Progress* for April, and was mentioned in the Notes column of NATURE on April 30 (p. 219). A further contribution on the same subject appeared in the form of correspondence by Sir Ronald Ross in the *British Medical Journal* from February 7 to March 28. Let us take Sir Ronald Ross's experiences first, and let us then extend the case to the university workers mainly considered in *Science Progress*.

Sir Ronald Ross was in the Indian Army Medical Service from 1881 to 1899, and not only did he discharge his official duties efficiently, but, at great trouble and expense to himself, he instigated his series of investigations on malaria and its transmission by mosquitoes—a task which prevented him from accepting a civil post which was offered him. The success of his researches led to the foundation in 1899 of the schools of tropical medicine in London and Liverpool, and though the scheme received every encouragement from Mr. Joseph Chamberlain and Mr. Austin Chamberlain, practically the whole of the money was raised by private subscription, although we do read of at least one Government grant of 3,550*l*. in 1899. As against this, we contrast the action of the German Government in financing the Hamburg Tropical School.

Sir Ronald Ross became chief lecturer of the Liverpool School, and thus had to resign his Indian commission on a small pension of under 300*l*. The work of the school was of an altogether exceptional character, involving expeditions to West Africa, teaching of students, publication of reports, and maintenance of experts on Government committees. In the expeditions Sir

Ronald Ross met with considerable local opposition from officials, but repeated efforts have finally resulted in the Indian and African Government departments taking action which has vastly improved the public health, and thus caused a large saving of life and of the financial resources of the countries.

In view of these facts, Sir Ronald Ross applied to the India Office for a pension on the higher scale, but this has been refused, and he has thus not only received no reward for his services to the country, but has been penalised by losing the pension which he would have received after full-time service.

We cannot help comparing this treatment to that which was meted out to the Pied Piper by the people of Hamelin, and the story is not unlikely to have a somewhat parallel sequel in the withdrawal of young enthusiasts from the field of scientific research. The Liverpool Tropical School is, we are told, in some danger of losing its staff because they are beginning to lose enthusiasm now that they realise that their duties offer them no prospects for the future, and no recognition of their work. The highest salaries now paid are 600*l*. a year with no fees, and much of the work is done voluntarily, or for a small honorarium. Had these people engaged in clinical work their possible incomes, if successful, would have been far greater.

Passing to the discussion in *Science Progress*, we are glad to see that that journal is instituting an inquiry into the salaries of university teachers and other persons holding paid appointments for work in science. The junior posts range generally from about 120*l*. to 200*l*., with a minimum of 85*l*. and maximum of 300*l*. For full professorships the most that a candidate has a reasonable prospect of securing is about 600*l*., with a small contributory pension on compulsory retirement at the age of sixty-five. In the colonies, salaries are not much higher, and not higher in proportion to the cost of living.

It must also be remembered that these salaries are in every case paid for teaching and lecturing work to classes of students, and the necessary routine work associated with the performance of these duties. The only way in which research can be benefited is by the appointment to such chairs of men of scientific distinction, and the provision of assistant lecturers sufficient in number to reduce the actual teaching of the professor to a limit that will allow him free time for undertaking scientific investigations outside the lecture hours. It is only when supervising and initiating work for research students that his scientific work can be included in the duties for which he receives direct payment. If the classes become larger without a corresponding increase in the college finances, his facilities for research are reduced. And such appointments are often only obtained after many years' waiting or tenure of junior appointments, a not inconsiderable portion of the salary of which has been spent in printing testimonials. A further burden on the junior lecturers is the necessity of writing researches or even books published at great expense with a view to the better recognition of their claims for the senior posts.

Many professors do no research, and these probably secure the largest numbers of examination successes and the smallest numbers of pupils who distinguish themselves after leaving college. A professor with fifteen hours a week lecturing *may* manage in a summer holiday to contribute a short note on a new application or modification of a known principle. With six or eight hours a week he may do more substantial work, but he will still cling to the development of known fields of study rather than proceed to the initiation of new fields. But occasionally a scientific worker lights on such a new and far-reaching idea that its development is incompatible with even three *efficient* lectures a week, not because of the *time* taken, but because it monopolises his *brain* to the exclusion of other thoughts. He has the alternative choice between abandoning the research or postponing it indefinitely or living on a reduced income in changed conditions of life calculated to unfit his health for the task he has taken.

Now there are undoubtedly many researches which can be delayed without any very obvious immediate loss to the community, but once an investigator has lighted on a well-defined plan of attacking such a problem as the spread of malaria, it becomes an enormous waste of national efficiency to allow anything to stand in his way of solving it at the earliest possible instant. He should have all facilities and appliances provided by the State, and it is the further duty of the State to reimburse him for any loss of salary which he has incurred by abandoning his previous career with this object in view.

The State grant in aid of scientific investigation is 4000*l*. a year to one learned society, and 1000*l*. for publications! The grants are, we believe, in every case contingent on returns of expenditure being made, and the actual scientific workers are unpaid. The money all goes into the pockets of mechanics, instrument makers, and printers who receive union rates of pay. The mechanism which drives the whole of the machinery receives nothing; and not only does he receive nothing, but, as our contemporary points out, he is often asked to give the Government gratuitous advice on scientific points without receiving any thanks for his services:—

> For example, a Government department wishes for expert advice on some matter—it ought to form a commission of its own and honestly pay the expert members of it. Instead of doing this, the Government department goes to some learned society and asks it to advise on the scientific question at issue. The society is honoured by the request, and obtains the advice gratis from its own members. Thus the Government gets what it requires for nothing; the learned body is overpowered with the honour rendered to it; and the unfortunate worker is the loser.

No system of emoluments could ever be sufficient to induce properly informed students to take up scientific work merely as a remunerative profession; unhappily some are now induced by scholarships to do so, and find out their mistake too late. What is required is that those who pursue scientific work with a well-defined object, and with a reasonable prospect of benefiting the State by their efforts should receive at least the remuneration which they would obtain if they left the work undone.

POPULAR NATURAL HISTORY.[1]

(1) We give a hearty welcome to "The English Year"—a series of charming studies in the Natural History of Autumn and Winter by W. Beach Thomas and A. K. Collet. There should be a shelf of these seasonable books—for there is a score of them already—in every country-house; and we should like to see a selection of them in every country school. For they are the best approaches to nature-study. The authors of this beautiful volume take nature as they find it—a moving pageant—and they discourse pleasantly and competently, in excellent style, on coveys of partridges, scattering seeds, cocoons of insects, migrant birds, withering leaves, fruitful hedgerows, showers of gossamer, winter visitors, hibernation, struggle with cold, trees in winter, the hailing of far summer, the salmon's journey, the early songs of birds, and much more besides. Some season-books (we hope for another volume of this one) are too enthusiastic, precious, and impressionist; others go to the opposite extreme of matter-of-fact-ness, and are rather dull "naturalist's calendars"; but the authors have found an effective middle way which is admirable. There are some characteristic notes on Norfolk by Mr. A. H. Patterson. The text is enlivened with numerous very interesting drawings by A. W. Seaby who has caught the spirit of things: and it is adorned by a series of reproductions in colour of the work of Sir Alfred East, Harry Becker, C. W. Furse, Buxton Knight, and Haldane Macfall. The whole book is capital value for its price and a credit to its publishers as well as to the authors and artists. We hope that it will have the success it deserves, and that it will help to stimulate the growing interest in seasonal natural history.

Ostrich Displaying. From "Highways and Byways of the Zoological Gardens."

(2) Mrs. Pocock has attempted "to carry the Zoological Gardens to those who are unable to go to them," and if she has not achieved this *en bloc*, she has certainly succeeded with particular

[1] (1) "The English Year. Autumn and Winter." By W. Beach Thomas and A. K. Collet. Pp. ix+408+plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 10*s*. 6*d*. net.
(2) "Highways and Byways of the Zoological Gardens." By Constance I. Pocock. Pp. xii+192+plates. (London: A. and C. Black, 1913.) Price 5*s*. net
(3) "The Moose." By Agnes Herbert. With 8 full-page illustrations by Patten Wilson. Pp. viii+248. (London: A. and C. Black, 1913.) Price 5*s*. net.
(4) "The Bodley Head Natural History." By E. D. Cuming. With illustrations by J. A. Shepherd. Vol. ii., British Birds, Passeres. Pp. 122. (London: John Lane, 1914.) Price 2*s*. net.
(5) "In the 'Once upon a Time'." By Lilian Gask. Illustrated by Patten Wilson. Pp. 288+plates. (London: George G. Harrap and Co., n.d.) Price 3*s*. 6*d*. net
(6) "Moths of the Limberlost." With Water Colour and Photographic Illustrations from Life. By Gene Stratton-Porter. Pp. xiv+370. (London: Hodder and Stoughton, 1912.) Price 10*s*. 6*d*. net.
(7) "My Game-Book" By Alan R. Haig Brown. Pp. xvi+239+plates. (London: Witherby and Co, 1913) Price 5*s*.

corners. As is always the way when a writer has a good story to tell and knows how to tell it, the book convinces and interests us, and we ask for more. Mrs. Pocock tells us about animals she has watched with an attentive and sympathetic eye, and her range is no restricted one—from orang-utans to millipedes, from the elephant to the elephant-shrew—and she throws in quaint items of information which will be fresh to many. If anyone wishes to know how apes received Prof. Boys's soap-bubbles, or what the mynah says to old gentlemen who peer into his cage, or how the ostrich woos his mate, or how the Old World porcupines advertise their presence, or of the vagaries of a snail that was wont at times to get out of its shell, let him read Mrs. Pocock's delightful book. She has been fortunate in securing unsurpassable photographs which adorn her tale, and one is here reproduced by the courtesy of the publishers.

(3) The story of the moose by Agnes Herbert is an effective biography, worked out with careful and convincing realism and not too obtrusively anthropomorphic. From the start when we read of the calf's enormous ears that "turned this way and that, one after the other, almost automatically, listening, listening. . . . ('it was as if the great flaps were so pleased with an hitherto unknown accomplishment that they could not but practise it'") . . . . to the end when we see the lynx sitting "in the lustrous, first light of day washing his glossy coat". . . . ("and as the big bull stood up stiffly, the cat leered over his shoulder and then went on licking fur") . . . . we have to do with scientific and artistic workmanship. There are eight excellent full-page illustrations by Patten Wilson.

(4) We have already expressed our appreciation of the Bodley Head Natural History, the second volume of which—on British Passeres—is now in our hands. Mr. Shepherd's clever drawings give us delightful glimpses of the behaviour and character of the birds, and Mr. Cuming's text is clear and interesting. We like some of his touches:—"the grasshopper warbler remains in the mind as a veritable mouse in feathers"; "the song, so-called, low and not unmusical, gives the impression that the dipper is singing to himself"; "your abiding impression of the tree-creeper is one of vanishing round the corner." The two little volumes we have seen are delightful, but we do not understand the dragging in of rarities like the subalpine warbler, Pallas's willow warbler, the greenish willow warbler, or even the wall creeper. What is the use of it in books of this kind?

(5) In the "Once upon a Time," Lilian Gask has been very successful in making a learned professor tell an active-minded boy about extinct animals and primitive man. The stories of "the ancient lords of land and sea," of man's life in the trees, of the finding of fire, of ancient hunters, and the like are told with accuracy, simplicity, and vividness. We have tried the book on a boy of twelve who thoroughly approved of it. The illustrations by Patten Wilson are full of interest and vitality. The preface stands badly in need of revision.

(6) The gorgeous work entitled "The Moths of the Limberlost" tells of studies made around a now dwindled swamp in north-eastern Indiana. The most living moths we ever saw fly about the pages, and the photographs are only surpassed by the water-colour drawings. The work must rank very high among beautiful "Nature-books," and there is good material in it too in the way of careful observation by a well-trained eye. It seems to us, however, that the text has been far too much diluted with talky stuff that is often utterly unimportant. There is also a regrettable and discordant "chaffing" of technical books and the mistakes they sometimes make. But the author is a true nature-lover who knows her moths and can depict them with unusual skill.

(7) In his "Game Book" Mr. Allen R. Haig Brown confesses that the love of the chase is worth more than all civilisation can offer and protests against the sentimentalism that credits animals with much in the way of pain or fear. He gives us an analysis of his grand total of 5,510 head in ten years, and tells us that he kills because he likes to, and because he wishes to keep the last remnants of nature from finding their way into "the maw of civilisation." He writes in a pleasant, straightforward way of ferreting and pike-fishing, of dogs and hares, of grouse and the "Trossacks," of fish that should be dead becoming lively again, and of other strange occurrences. There are numerous, pretty illustrations throughout the volume, but the insertion of the verses shows a surprising lack of humour. The book is a naïve expression of "the exquisite pleasure that there is to be gathered from the birds and beasts of the chase in the pleasant places of our own dear land."

THE ROGER BACON COMMEMORATION AT OXFORD.

THE arrangements for the commemoration of the seven hundredth anniversary of the birth of Roger Bacon are now well advanced. The day appointed for the ceremony is Wednesday, June 10; the place, as is fitting, being Oxford. Proceedings will begin at noon with the unveiling, by Sir Archibald Geikie, of Mr. Hope-Pinker's statue of the great Franciscan, and its reception by Earl Curzon on behalf of the University. Addresses will be presented by delegates representing various bodies who have joined the movement, and the public orator, Mr. A. D. Godley, will deliver a Latin oration. All this will take place at the university museum. The delegates and some other visitors will be entertained at lunch by the Warden and Fellows of Merton College, and doubtless other lunch parties will be arranged. At three o'clock all visitors will have the opportunity of attending the Romanes lecture. This will be given in the Sheldonian Theatre, the lecturer being Sir J. J. Thomson, of Cambridge, and his subject the atomic theory. From one to four o'clock various manuscripts and other objects of interest in connection with Roger Bacon and his successors will be on view in the Bodleian Library, and from four to half-past six a garden party will be held at Wadham College.

At the approaching celebration the Vatican library will be represented by Mgr. Ratti, the Institut de France by the Comte d'Haussonville, the University of Paris by Prof. Picavet, the University of Cambridge by Prof. James Ward, the Order of Friars Minor by Dr. P. Hickey, Provincial, and Prof. Paschal Robinson, the Capuchin Order by Fr. Albert (vicar-provincial), and Fr. Cuthbert.

Much has been done of recent years to establish the importance of the work of Roger Bacon in the history of Western thought. His eminence as a linguist, an educational reformer, a mathematician, and physicist was well brought out in the discourse lately delivered by Sir John Sandys before the British Academy. The late Prof. Adamson, speaking of his works, both edited and at present existing only in manuscript, wrote as follows in the "Dictionary of National Biography":—

It is much to be desired that a more thorough and detailed study of the known manuscripts and a more extensive search for others which doubtless exist should be undertaken. Some portions are in a condition suitable for publication, and it is well-nigh an obligation resting on English scholars to continue the good work begun by the late Prof. Brewer. Bacon's works possess much historical value, for his rigorous thinking and pronounced scientific inclinations are not to be regarded as abnormal and isolated phenomena. He represents one current of thought and work in the Middle Ages which must have run strongly though obscurely, and without a thorough comprehension of his position our conceptions of an important century are incomplete and erroneous.

Prof. Picavet, of the Collège de France, adds his testimony as follows:—

L'autorité et le raisonnement ne valent, pour Roger Bacon, qu'en fonction de l'expérience. C'est elle qui doit prononcer en dernier ressort sur les affirmations des anciens comme sur nos propres conceptions. . . . Roger Bacon a donc entre les mains l'instrument qui a rendu possibles toutes les conquêtes de la science moderne.

Subscribers of one guinea and upwards to the Roger Bacon commemoration fund will be entitled to take part in the ceremonies at Oxford, and also to receive the memorial volume, which will contain essays dealing with various aspects of Roger Bacon's work, written by specialists in the various subjects. Subscriptions should be sent to Col. W. H. L. Hime, 20 West Park Road, Kew.

SIR JOSEPH WILSON SWAN, F.R.S.

WE regret to announce the death, in his eighty-sixth year, of Sir Joseph Swan, at Warlingham, Surrey, on May 27. Swan came from a stock exceptionally endowed with inventive abilities on both the paternal and maternal sides, his father and his maternal uncle, Robert Cameron, having both been inventors of note. He was born at Sunderland on October 31, 1828, and there he received his education. He was removed from school at an early age, and having shown a decided taste for chemistry, was apprenticed by his father in the chemical business of Mawson, of Newcastle; of this firm Swan subsequently became a partner, the firm's name being changed to that of Mawson and Swan. At the commencement of his career Swan turned his attention more particularly to the manufacture of photographic supplies, and it is owing to his enterprise that the business of his firm was largely extended in this direction.

The nature of the business with which young Swan was thus associated enabled him to turn to account his inventive talent in bringing about important advances in photography. His patent for carbon printing, being the first commercially practicable process of the kind, was filed in 1862; later he described it in a paper read by him before the Photographic Society in April, 1864. Although the process has been simplified and improved by subsequent workers, in its essential features Swan's invention remains the basis of some of the methods of photographic reproduction still largely in use at the present day. An original investigation made by Swan on the effect of heat in increasing the sensitiveness of a gelatino-bromide silver emulsion led to the production by him of extremely rapid dry plates in 1877, and two years later he invented the bromide printing process.

Swan is, perhaps, better known to the public in connection with his invention of the incandescent carbon filament lamp than in connection with his discoveries in the field of photography. As a lad he had, in 1845, seen the experiment carried out of heating platinum-iridium wire to incandescence by means of an electric current, and this principle was applied by him, so far back as 1860, in the construction of an electric glow lamp, in which strips of carbonised paper or card mounted within an exhausted glass globe were raised to a red heat by an electric current obtained from primary batteries. At that date the method available for obtaining a vacuum was not entirely satisfactory, and in consequence the life of the earliest type of glow lamp was exceedingly short. However, when Sprengel's mercury pump for producing vacua made its appearance in 1865, Swan again turned his attention to the problem of producing a marketable electric glow lamp. Experiments carried out by him showed that high vacua were necessary to prolong the life of the incandescing filaments of which he had been investigating the properties.

In February, 1879, Swan exhibited his improved electric glow lamp at a meeting of the Newcastle Chemical Society, and the first public demonstration on any considerable scale of this new method of illumination was given before the Newcastle Literary and Philosophical Society in October, 1880. In the following month Swan read a paper before the Institution of Electrical Engineers on "The Subdivision of the Electric

Light," in which the suitability of the electric glow lamp for domestic lighting was dealt with.

Swan played a considerable part in connection with the introduction of the improvements in the manufacturing processes which have resulted in the successive reductions in the price of the glow lamp. To him was due the introduction of the "parchmentised thread" filaments formed by treating ordinary crochet cotton-thread with sulphuric acid and then carbonising the same; later he devised the process whereby filaments of exceedingly small diameter and great uniformity were obtained by squirting artificial cellulose by hydraulic pressure through a die; the latter being first shown to the public at the Inventions Exhibition in 1885. It is only very recently that this process of manufacture has given place to the newly developed metal filament lamps.

Swan's activities in the field of electro-chemistry resulted in the invention by him of a rapid process of depositing copper, due to the discovery made by him that the addition of a suitable quantity of gelatine to the solution in the electro-depositing bath much improved the quality of the deposited metal. The process admits of the utilisation of currents of from 1000 to 1500 amperes per square foot of kathode, pure copper wire being at once reeled off from the bath through a die. Swan devoted his attention also to apparatus for measuring electric current, and the improvement of secondary batteries; his activities in the field of invention resulted in the filing of some sixty patent specifications, some in his name alone and others in the joint names of himself and his eldest son.

A recognition of Swan's services to applied science came first from France when, in 1881, he was appointed Chevalier of the Legion of Honour. In 1894 he was elected a Fellow of the Royal Society, and ten years later received a knighthood. The University of Durham also conferred upon him the honorary degrees of M.A. and D.Sc. He was the recipient, in 1903, of a gold medal from the Society of Chemical Industry, and, in 1904, of the Hughes medal from the Royal Society. In 1906 the Royal Society of Arts awarded him its Albert medal, "for the part he took in the invention of the incandescent lamp and for his invention of the carbon process of photographic printing," the medal being presented to him by King George (at that time Prince of Wales).

The career of Swan demonstrates that a scientific training and the possession of inventive faculties are not, as some suppose, necessarily incompatible with the possession of sound business capacity; and, indeed, the subject of this memoir gave ample evidence by his life work that it is possible for a man to be a productive inventor and at the same time successful as a commercial manager.

In Sir Joseph Swan the nation has lost not only a venerable investigator, whose labours did much for the material progress of civilisation, but one who was also possessed of a charming personality which deservedly endeared him to a large circle of friends and acquaintances. W. A. J. O'M.

DR. P. H. PYE-SMITH, F.R.S.

PHILIP HENRY PYE-SMITH was born August 30, 1839, at Billiter Square, E.C. He was the eldest son of Ebenezer Pye-Smith, F.R.C.S., and the grandson of the Rev. Dr. John Pye-Smith, F.R.S., the principal of the Homerton Theological College, well known, nearly a century ago, both as a geologist and theologian. He belonged to a medical family, for his father was a surgeon in the city, his brother Rutherford John Pye-Smith is emeritus professor of surgery at the University of Sheffield, and a nephew is also in the profession.

Dr. Pye-Smith was educated at Mill Hill School, and in 1858 took the B.A. of the University of London. He then entered Guy's Hospital Medical School and attained his M.D. in 1864; he gained the gold medal, thus outstripping two future distinguished colleagues, Moxon and Sir Thomas Stevenson. After a year at continental schools his teaching began by his being appointed demonstrator of anatomy. In 1871 he became assistant physician to Guy's Hospital, and full physician in 1883. He retired from the active staff in 1899, as in that year he reached the retiring age of sixty. He then became consulting physician to the hospital. During the earlier part of his assistant physiciancy he lectured on comparative anatomy, then on physiology, and when he was full physician on medicine. For many years he took charge of the department of diseases of the skin, and was regarded everywhere as one of the highest authorities in this branch of medicine.

In 1870 Pye-Smith was elected a Fellow of the Royal College of Physicians, and he later became examiner, a member of the council, and a censor. From 1900–9 he represented the college on the senate of the University of London, and held the office of vice-chancellor from 1903 to 1905. He was elected a Fellow of the Royal Society in 1886, and served on the council of the society in 1891–92. In 1899 he was appointed by the British Government joint representative with Sir Heron Maxwell at the International Congress on Tuberculosis in Berlin. He was a member of the General Medical Council and treasurer from 1901–7. He gave the address in medicine at the meeting of the British Medical Association at Ipswich in 1900. He was an hon. M.D. of the University of Dublin, an honorary fellow of the Royal College of Physicians of Philadelphia, and of the Royal Academy of Medicine in Ireland.

In 1883 his colleague Fagge died, leaving by his will the manuscript of his famous book on medicine to Pye-Smith for him to complete and see through the press. Pye-Smith greatly appreciated this act of his friend; he worked hard at the task, and was the means of giving to the world one of the best and most original books on medicine. He kept it up to date and edited the subsequent editions, so that it gradually contained more and more of Pye-Smith's writing, and the later editions were published as under the joint authorship of Fagge and Pye-Smith. This was his outstanding work, but he wrote many medical papers, publishing the chief of them in the Guy's Hospital Reports. He contributed the article on Harvey in the "Encyclopædia Britannica," and delivered the Harveian oration in 1893. He was an admirable speaker, always saying just the right thing in just the right way. Nothing could have been better than the speech he made at the dinner given to Sir Samuel Wilks by his many admirers when he became a baronet.

Pye-Smith's honesty, his high ideals, his geniality, his affection for all learning—modern or ancient, medical or non-medical—and his many kindnesses especially to younger members of the profession, gave him troops of friends, and no one took more pleasure than he in getting them around him. All who knew him admired and liked him. Unhappily, illness kept him in retirement for several years before his death on May 23. In 1894 he married Gertrude, the youngest daughter of the late Arthur Foulger. She and their only child—a son—survive him.

NOTES.

The Croonian Lecture of the Royal Society will be delivered on Thursday, June 11, by Prof. E. B. Wilson, of Columbia University, on the bearing of cytological research on heredity.

The Institution of Electrical Engineers will hold a conversazione at the Natural History Museum, South Kensington, on Thursday, June 25. A conversazione of the Institution of Civil Engineers will be held at the institution on Thursday, July 2.

Prof. Metchnikoff, of the Pasteur Institute, is to be presented with a "golden" book to celebrate his scientific jubilee and his seventieth birthday. Prof. Metchnikoff, whose scientific work in zoology and microbiology is of a high order, is best known to the general public as the author of "The Prolongation of Life" and "The Nature of Man."

At the Laryngological Section of the Royal Society of Medicine on May 27, Prof. Gustav Killian, of Berlin, demonstrated his method of examining the larynx and its annexes by means of a new instrument, the "suspension" laryngoscope. At the same time, a case of cancer of the throat was shown which had been treated by high-frequency electric currents—so-called diathermy—with promising results.

The triennial Parkin prize of 100*l.* in the gift of the Royal College of Physicians of Edinburgh, has been awarded to Dr. Johnston-Lavis. The subject set was, "On the Effects of Volcanic Action in the Production of Epidemic Diseases in the Animal and in the Vegetable Creation, and in the Production of Hurricanes and Abnormal Atmospherical Vicissitudes." The prize essay will be published in book form by Messrs. Bale, Sons and Danielsson, Ltd.

Several important earthquakes have occurred during the past week. On May 26 a violent earthquake, the centre of which may have been in Central or South America, was recorded in European observatories. On May 27 another strong shock was felt at Panama, but again without damaging the canal works. On the same day an earthquake of unusual intensity, which seems to have originated near Tonga, was recorded at Sydney, the disturbance lasting for three hours.

Mr. W. B. Grove, writing from the University of Birmingham, says that any person interested in the study of the Uredinales may obtain a supply of the rare and remarkable parasite, *Puccinia vincae*, in a fresh condition, by sending a stamped and addressed envelope, or other suitable covering, to him at 46 Duchess Road, Birmingham. The specimens show an abundance of the curious debatable bodies called by Plowright "æcidia."

The seventh congress of the International Association for Testing Materials will be held under the patronage of H.M. the Czar of Russia, in St. Petersburg, on August 12–17, 1915. Four days will be devoted to the discussion of the most important problems on testing materials. After the congress extensive excursions in the interior of Russia have been arranged. The offices of the British section of the Association are at the Iron and Steel Institute, 28 Victoria Street, London, S.W.

The council of the Royal Society of Edinburgh has awarded the following prizes:—(1) The Neill prize for the biennial period 1911–12, 1912–13 to Dr. W. S. Bruce, in recognition of the scientific results of his Arctic and Antarctic explorations; (2) the Keith prize for the biennial period 1911–12, 1912–13 to Mr. J. Russell, for his series of investigations relating to magnetic phenomena in metals and the molecular theory of magnetism, the results of which have been published in the Proceedings and Transactions of the society, the last paper having been issued within the period.

Mr. James W. Munro, Wolfe-Barry student in entomology at the Imperial College of Science and Technology, South Kensington, who is engaged in working out the life-history of *Xestobium tesselatum* with regard to the roof of Westminster Hall, will be glad to be informed of any timber known to be affected with this beetle, and whether it would be possible for him to obtain it by purchase or to examine it for living beetles. He adds:—"Owing to the precarious condition of Westminster Hall roof, it is desirable that my investigations be carried out as soon as possible and a large supply of living beetles is the first essential."

Sensational paragraphs on seeing by wire have been going the rounds of the daily Press, but there is no indication in these accounts of anything fundamentally different from the plans that were put forward in the early days of the Physical Society, when the late Mr. Shelford Bidwell, Prof. Ayrton, and others were experimenting with selenium. At that time mosaics of selenium were going to do all that is promised now, but they never did. It may be that Dr. A. M. Low, whose apparatus has been described in perfervid terms in the daily Press, has made some progress, but the published accounts of the invention as "the latest scientific discovery" are absurd.

The trustees of the Ray Lankester Fund are prepared to appoint the "Ray Lankester Investigator" for 1914. The fund has been founded in connection with the Marine Biological Association of the United Kingdom, and enables the trustees to rent a table at the Plymouth Laboratory of the association, and from time to time to appoint to it an investigator for twelve months. The investigator appointed will be expected during the year to spend a total of five months, which need not be continuous, carrying on his researches at Plymouth. The biologist appointed receives from the trust 70*l.*, of which half is to be paid to him when he enters into occupation of his table, and the other half when the five months' research is completed. Applications should be addressed to the director of the laboratory at Plymouth.

We notice with regret the death, in his fifty-first year, of Prof. George Dean, Regius professor of pathology in the University of Aberdeen. After a distinguished career as a student in the Universities of Aberdeen, Berlin, and Vienna, Prof. Dean became University assistant to the professor of pathology at Aberdeen. In 1897 he was appointed bacteriologist in the serum department of the Lister Institute, and became senior bacteriologist in 1906. He was the author of numerous medical articles and of contributions to the Proceedings of the Royal Society and the transactions of other learned societies. He also introduced a rapid method of immunisation used in the preparation of diphtheria antitoxin. He was a member of the War Office Commission on Typhoid Inoculation.

The tragic ramming and sinking of the steamer *Empress of Ireland* in the St. Lawrence River, resulting in the loss of more than one thousand human lives, gives particular interest to the article on the *Aquitania* in *Engineering* for May 29. This article deals at length with the subdivision of the ship by bulkheads and the effect on the buoyancy of flooding several compartments at either bow or stern, or wing compartments. Diagrams and curves are given showing that five compartments from the bow or five from the stern, including the three turbine rooms, may be flooded and still leave a satisfactory margin of safety. With all the wing compartments on one side of the ship flooded (taking 5320 tons of water), the ship would heel to the extent of 26°, which is not in any way excessive, although the contingency of such flooding is so remote as to be declared almost impossible. The fore-and-aft bulkheads on each side of the space occupied by the boilers extend for a distance of 450 ft. and are 18 ft. from the ship's skin, thus securing practically a "ship within a ship." The *Aquitania* left Liverpool for her maiden voyage on Saturday, May 30.

At the meeting of the Cambridge Philosophical Society held on May 18 the following were elected honorary members of the society:—Dr. H. E. Armstrong; Prof. J. Bordet, the University, Brussels; Madame Curie, the Sorbonne, Paris; Prof. F. Czapek, the German University, Prague; Prof. T. W. Edgeworth David, the University, Sydney; Colonel W. C. Gorgas, Medical Corps, U.S.A. Army; Prof. P. H. von Groth, the University, Munich; Prof. Jacques Hadamard, the College of France, Paris; Dr. G. E. Hale, director of the Mount Wilson Solar Observatory; Dr. François A. A. Lacroix, Natural History Museum, Paris; Prof. C. Lapworth, late professor of geology, the University, Birmingham; Prof. H. Lebesgue, the Sorbonne, Paris; Dr. Jacques Loeb, the Rockefeller Institute, New York; Prof. Arthur Looss, the Government School of Medicine, Cairo; Prof. H. A. Lorentz, the University, Leyden; Prof. M. Planck, the University, Berlin; Lieut.-Col. Leonard Rogers, the Medical College, Calcutta; Prof. Gustav Schwalbe, the University, Strassburg; Dr. Karl Schwarzschild, the University, Berlin; Dr. D. H. Scott, foreign secretary, Royal Society; Prof. E. B. Wilson, Columbia University, New York; A. F. Yarrow, Blanefield, Glasgow; Prof. P. Zeeman, the University, Amsterdam. The society will celebrate in 1919 the centenary of its foundation.

In *Peru To-day* (December, 1913) an interesting account is given of the anti-yellow fever campaign in Iquitos. This principally comprised measures for the destruction of the mosquito-carrier of this disease, the Stegomyia. Previously 500–600 deaths occurred annually from yellow fever, but since the institution of these measures not a single death from yellow fever occurred during the first seven months of 1913. The cost has been about 300*l.* a month.

"Organisms and Origins" is the title of Prof. Dendy's presidential address to the Quekett Microscopical Club (*Journ. Quekett Microscop. Club*, April, 1914, p. 259). The origin of life was dealt with, and reference was made to Dr. Charlton Bastian's experiments. While admitting that Dr. Bastian's *a priori* position is a strong one, Prof. Dendy doubts if comparatively highly organised beings can be evolved so rapidly as seems to be the case in Dr. Bastian's solutions.

A course of three public lectures on altitude and health has recently been delivered by Prof. Roget, of Geneva, under the Chadwick Trust. The lecturer directed attention to the changes which occur in the blood at high altitudes, to the relative freedom of the air from micro-organisms, and to the richness of the solar light in violet and ultra-violet rays. Exposure of the unclothed body to the brilliant alpine sun of winter exercises a marked curative effect on tuberculous conditions.

With reference to the mutations of *Bacillus anthracis* induced by exposure to ultra-violet rays (Nature, April 23, p. 193), attention may be directed to the power which bacteria possess not only of secreting enzymes, but also of adapting the enzyme they secrete to the soil on which they are growing. Thus a bacterium which has been secreting peptonising enzymes on a protein soil will secrete a diastatic enzyme when transferred to a carbohydrate soil, as was demonstrated by Sir Lauder Brunton and the late Dr. Macfadyen (Proc. Royal Soc., vol. xlvi.).

In the issue of *Folk-lore* for March, recently issued, Mr. W. Crooke discusses the remarkable vernal fire festival of the Hindus, known as the Holi. A primitive form of the rite is the burning of a tree or pole, apparently symbolising the burning of the old year. To this are added various observances—fire-walking, swinging, burning of bush-fruits—which seem to be connected with the cult of fertility.

AT the last meeting of the Society of Antiquarians of Scotland, Mr. Ludovic Mann discussed certain elaborately carved balls of stone, of which some two hundred examples are known. It was believed that they were found in interments of the bronze and stone ages; but the style of decoration points to the conclusion that they range through the first two or three centuries of our era. Mr. Mann produces some strong evidence to show that they were used as movable poises or weights on weighing beams. He believes that they originated with the Roman *statera*, and that they throw light on the conditions of commerce in Scotland some two thousand years ago.

SINCE oceanography is a subject in which Norwegian physicists and naturalists have taken a prominent part, it is appropriate that a full memoir upon this branch of science appears in the April number of *Naturen*.

SUGGESTIONS with regard to the establishment of special rooms for children in museums are contributed by Mr. W. R. Butterfield, of the Hastings Museum, to the May issue of the *Museums Journal*. To anyone who has watched the aimless manner in which parties of children wander through the galleries of the Natural History Museum, the need and advisability of such special rooms—if only they can be made to attract the class for whom they are intended—will be self-apparent.

THE Zoological Society of Scotland is to be heartily congratulated on the complete success attending the first year's working of the Zoological Park, Edinburgh, of which a full account is given in the report of the council for the year ending March 31, a report notable on account of the number and beauty of the illustrations. Among donations to the menagerie mention may be made of a consignment of antarctic seals and penguins from Messrs. Chr. Salvesen and Co., of Leith, several antelopes and deer from the Duke of Bedford, and an elephant from the Maharaja of Mysore.

A PHOTOGRAPH of the pair of young sea-elephants, or elephant-seals, recently presented by the Duke of Bedford to the Zoological Society forms one of the most striking features in the May number of Mr. Douglas English's *Wild Life*. It is to be regretted that in the accompanying letterpress no mention is made of their place of origin, and the statement that "Head" Island (instead of Heard Island) is one of the breeding places of the species is misleading. It may also be mentioned that "neoteny" (p. 16) is not a term likely to be familiar to the class of readers for whom this publication is intended.

SEVERAL observers have in recent years experimented on the eggs of various animals by means of the centrifuge, with the view of determining the effects upon development of a redistribution of the various constituents of the cytoplasm. The latest contribution to this particular branch of the science of experimental embryology is a long memoir by Dr. J. W. Jenkinson, "The Relation between the Structure and the Development of the Centrifuged Egg of the Frog," published in the *Quarterly Journal of Microscopical Science* (vol. lx., part 1). This author finds that, as a result of centrifuging, the constituents of the cytoplasm are driven past one another in opposite directions, and that this disarrangement brings about distortion of development, or even prevents it altogether. Normal development appears to be conditioned by a definite arrangement of the visible cytoplasmic constituents, with the exception of the pigment. The yolk, glycogen, and fat, not being living substances, cannot, however, be properly termed organogenetic, and no evidence of the existence of distinct organogenetic bodies in the living protoplasm was obtained in the case of the frog's egg. Dr. Jenkinson arrives at the general conclusion, however, that the causes upon which the primary differentiation of the embryo depends are located in the cytoplasm. He maintains that the cytoplasm transmits those characters which determine the large group to which an organism belongs. Generic, specific, and varietal characters, on the other hand, are supposed to be carried by the chromatin substances of the nucleus, which, however, depends upon differences in the cytoplasm for the manifestation of its activities.

ACCORDING to investigations by Mr. J. N. Currie on the flavour of Roquefort cheese (*Journal of Agricultural Research*, vol. ii., No. 1) it has been found that a considerable amount of the fat is hydrolysed during the ripening period. The chief factor in this process would appear to be *Penicillium roqueforti*, which produces a water-soluble lipase, and thus leads to the accumulation of the acids of milk fat in both the free and combined forms. Of these acids, caproic, caprylic, and capric, and their readily hydrolysable salts, have a peppery taste, and are responsible for the characteristic burning effect of Roquefort cheese upon the tongue and palate.

SIR T. H. HOLLAND provides a very valuable bibliographical and critical index to "Indian Geological Terminology" in vol. xliii., part 1, of the Memoirs of the Geological Survey of India. Such lists are seldom readable, being intended only for reference; but in this case a student, going through these well-written pages with a map of India at his side, will learn a great deal about the geology of the country, and, incidentally, about the men who have developed our knowledge and the principles of stratigraphical research.

THE Geologists' Association furnishes in its Proceedings much useful information as to districts visited on excursions, and many of the descriptive papers serve to bring our text-book knowledge up to date. In recent issues a valuable series of papers has appeared on the Aberdeen and Arbroath area (vol. xxiii., part 5). The picturesque regions of southern Mayo and Sligo, still too little known, are described in vol. xxiv., part 2, with eight photographs of scenery and rock-structure; while the Mesozoic beds round

Nottingham are excellently illustrated in vol. xxv., part 2. In this last part, moreover, H. Dewey and R. A. Smith sustain the view that the sequence of Palæolithic culture at Swanscombe, in Kent, is identical with that established in France and Belgium. The publications of local societies also bear witness to the activity of geological observers, and especially of the amateurs who add so much to scientific knowledge in England. H. C. Beasley thus continues the description of the remarkable Triassic footprints at Storeton (Proc. Liverpool Geological Society, vol. xi., part iv.), and D. Woolacott furnishes an important paper on the stratigraphy and tectonics of the Permian of Durham (Proc. Univ. of Durham Philosophical Society, vol. v., part 5).

THE recent memoirs of the Geological Survey of Great Britain, each of which describes a sheet of the series of colour-printed maps, include "The Country around Newton Abbot," by W. Ussher and other authors, and "Fareham and Havant," by H. J. O. White. In the former, Clement Reid confirms Heer's correlation of the Bovey Tracey Beds with continental representatives now classed as highest Oligocene. The map (Sheet 339) includes the edge of the Dartmoor granite, and the seaside resorts of Exmouth, Dawlish, and Teignmouth, and, with the memoir, should be of great service to visitors in this very varied region. The Havant map and memoir pleasantly continue the series devoted to the Downs and the Cainozoic synclines of south-eastern England. Scotland furnishes Memoir and Sheet 82, on Central Ross-shire, and Memoir and Sheet 92, on the Fannich Mountains and Strath Broom. The names of B. N. Peach and J. Horne appear among the authors of both these publications, which deal with wild districts of pre-Cambrian and Cambrian rocks. Despite their moderate price (2*s.* 3*d.* and 2*s.* 6*d.*), both works are illustrated with landscapes which are chosen with the eye of a geologist, but which will equally delight any lover of the highlands. The many students of thrust-structure and mountain-building will find new diagrams and new material in both these interesting memoirs.

"THE Oil Resources of the Empire" formed the subject of an address by Dr. F. M. Perkin, recently delivered before the Society of Arts, and published in the Journal of the society (vol. lxii., No. 3204). It is not generally realised how vast is the consumption of mineral oils in the United Kingdom, and how small a proportion is supplied from within the Empire itself. Out of a consumption of more than four million gallons only 2·67 per cent. was derived from British sources. It is hoped that by systematic surveys new sources of supply may be located, and valuable sources of oil may in future be found in the great shale beds of Tasmania. Much, too, remains to be done in increasing the supply of vegetable oils, more particularly of linseed oil, which might with advantage be produced extensively on British soil. One of the most striking features of recent years has been the rise of the soy oil industry, and in view of the fact that the crushing industry has now fallen largely into Japanese hands, it is suggested that attempts should be made to cultivate the soy plant in British territory.

AMONG recent American papers on the chemistry of soils the following may be noted. Mr. G. W. Wilson, in the *Biochemical Bulletin* (vol. ii., No. 10), reports a series of experiments on the effect of heating the soil on plant growth. It appears that heating the soil to a temperature of 95° C. caused slight acceleration of growth, but a higher temperature (135° to 175°) brought about a marked retardation; plants grown on the heated soil were more susceptible, however, to attack by parasitic fungi. In the same number of the *Biochemical Bulletin*, Mr. A. W. Thomas gives a convenient summary of the methods adopted by Schreiner and Shorey for isolating and detecting organic soil constituents, whilst in the *Journal of Agricultural Research* (vol. i., No. 5, p. 357) Mr. E. C. Shorey describes the isolation of certain derivatives of benzene from samples of sandy soil from Florida at present devoted to orange culture. These compounds were benzoic acid (350 lb. per acre foot), metahydroxytoluic acid (800 lb.), and vanillin (40 lb.), of which the latter at least appears to exist in the soil in the free state, probably being an unchanged residue of plant débris.

VOL. LXVII. of the *Annalen der Physik* contains an important series of four papers, one by Prof. Stark alone, and three by him in cooperation with others, on the effect of electric fields on spectrum lines. Since the discovery of the magnetic change of radiation frequency by Zeeman, various physicists have tried to discover an analogous electric effect. Prof. Stark has succeeded in affecting the spectrum lines emitted by canal rays in a vacuum tube by submitting them to an electric field, ingeniously arranged between a perforated kathode and an auxiliary electrode at a few millimetres' distance. The field intensity amounts to 30,000, and in some experiments even to 47,000, volts per cm. When the observation is made at right angles to the field, the spectrum lines are split up into polarised components under the action of the field, which proves to be rather homogeneous. The separation of the components is proportional to the field intensity. The hydrogen, helium, and lithium lines are studied in detail. For the line H_β (4861 Å.U.) the separation of the outer components, which vibrate parallel to the field, becomes about 8 Å.U. in a field of 28,500 volts per cm. In a direction parallel to the electric field the components of the resolved lines are unpolarised. The analogy between the Zeeman effect and the electric effect consists in the spectrum lines being resolved by both kinds of fields; but in all details there are great differences. The magnetic resolution is, with some limitations, the same for all lines belonging to the same spectrum series, and it decreases toward the violet end of the spectrum. The electric resolution is different for succeeding lines of a series, and the effect increases with decreasing wavelengths. Diffuse lines are most strongly affected by the electric field. The two yellow sodium lines show only a very small electric effect. The mechanism of the magnetic effect is certainly understood in its main features, but the exact meaning of the electric effect is still obscure.

LAST week's *Times Engineering Supplement* contains an excellently written article by Prof. J. A.

Fleming on recent scientific research in telephony. It is a description of the practical developments which have been the outcome of mathematical investigations (originated in the first place by Mr. Oliver Heaviside) into the effect of inductance in telephone circuits, followed much later by painstaking experiment and trials on a large scale. A quarter of a century ago, Heaviside's insistence that the solution of the problem of long-distance telephony lay in the distribution of inductance throughout the line met with a cold reception by the engineering department of the Post Office. Heaviside would do no more than expound his theory in his own way, and with his own mathematical notation, leaving its development to the "practicians"; but the practicians of those days were lacking either in the ability or the inclination to study his writings. It is one of the saddest things in the history of British science that Heaviside's work should then have been regarded as possessing no more than an academic value, and that his suggestions did not take practical effect in this country until they had been revived by an American many years later, and sent back to us as a new invention. Prof. Fleming clearly explains the present application of distributed inductance in enabling us to telephone over enormous distances; he describes the "phantom" circuit which permits two pairs of lines to be employed for three conversations simultaneously; he has remembered to mention the effect of reflection at junctions between overhead and underground lines, and concludes with a plea for further systematic investigation; but he has forgotten one thing: Oliver Heaviside's name does not appear once in the article.

THE June issue of the catalogue of Mr. Francis Edwards, 83 High Street, Marylebone, London, W., is concerned with miscellaneous literature, and gives a clearance list of second-hand books in a great variety of subjects. The sections dealing with alpine studies, birds, and general natural history are of special interest.

PROF. WALTER RIPPMANN, who has been for some time actively associated with the movement for spelling reform, asks us to state that though he could subscribe to most of what is said in the review of Mr. Archer Wilde's "Sounds and Signs," signed "W. R.," in NATURE of May 28, the review should not be attributed to him.

The following are among the forthcoming books of science announced by the *Cambridge University Press*:—The Royal Society's Catalogue of Scientific Papers, vol. xiii., covering the letters A and B; The Life, Letters, and Labours of Francis Galton, compiled by Prof. Karl Pearson, 2 vols; The Philosophy of Biology, by Dr. J. Johnstone; Ancient India, by Prof. E. J. Rapson; English Folk-Song and Dance, by F. Kidson and M. Neal; Perception, Physics, and Reality, by C. D. Broad; Philosophy: What is it? by Dr. F. B. Jevons; Mechanical Drawing, by J. H. Dales; Household Science, by C. W. Hale; The Place-Names of Sussex, by R. G. Roberts; Geography of the British Isles, by Dr. Mort; Pond Problems, by E. E. Unwin, and Bird Studies, by W. P. Westell; the *Oxford University Press* will publish shortly The Oxford Survey of the British Empire, in six 8vo volumes, edited by Prof. A. J. Herbertson and Mr. O. J. R. Howarth, in collaboration with seventy-three contributors; and *Messrs. Rivingtons* give notice of A Course of Geometry—Theoretical and Practical, by A. H. Bell, and a cheaper edition of Machine Drawing and Design, by Dr. W. Ripper.

OUR ASTRONOMICAL COLUMN.

ROTATING NEBULÆ.—In the *Daily Mail* of May 27 the following cablegram addressed to Prof. Lowell was published:—"Flagstaff, Arizona. Spectrograms show Virgo nebula rotating. Slipher." Up to the time of writing no further information is at hand, and it is not certain which is the nebula in question. The discovery is one of extreme importance, because, although the majority of nebulæ are of the spiral form, and such shape suggests a motion round a centre, a direct determination of the velocity of movement puts this question of movement beyond doubt. The observation is a most delicate one and requires all the resources of modern instrumental equipment and the best of observing conditions.

COLLATED LIST OF LUNAR FORMATIONS.—Selenographers will welcome the issue of the collated list of lunar formations, named or lettered in the maps of Neison, Schmidt, and Mädler, which has been compiled and annotated by Miss M. A. Blagg, under the direction of the late Mr. S. A. Saunder. It was due to Mr. Saunder's energy that a lunar nomenclature committee of the International Association of Academies was formed. Finding that lunar nomenclature was in an unsatisfactory state he desired to remedy the defect by having a nomenclature adopted once and for all by universal assent. This publication therefore forms the basis on which the names of the formations can be adopted. The preparation of an accurate map of the moon in mean libration was also undertaken by Messrs. Saunder and Franz, and it is hoped that this chart will soon be completed. Prof. Turner, in the introduction to the volume, directs attention to the severe losses by death of the committee, namely, Loewy, Newcomb, Saunder, and Franz, necessitating the nominal direction of it being placed in his hands.

THE LIGHT OF STARS.—The March number of *Le Radium*, which reached us a few days ago, contains a paper by Dr. A. H. Pfund, of Johns Hopkins University, in which he describes some preliminary tests he has made of a new apparatus for measuring the light of a star. The work was done at the Allegheny Observatory, the Keeler 30-in. reflector being used. In the focus of the telescope, either of two small blackened discs which formed the junctions of a thermo-circuit could be placed. The wires used for the thermo-element were alloys of bismuth and tin, and of antimony and bismuth respectively. They were enclosed in an evacuated capsule closed at one end by a plate of fluorite and substituted for the eyepiece of the telescope. The thermo-current was measured by a moving-coil galvanometer. The sensitiveness of the arrangement was such that a candle at a distance of eight miles would give a deflection of one millimetre. The deflections obtained from celestial objects were: Vega, 7·5; Jupiter, 3·0; Altair, 2·0 mm. The author hopes by using a more sensitive galvanometer and other materials for his thermo-elements, to increase the sensitiveness considerably, and in this way to open up a new field of astrophysical research.

THE SPECTRUM OF η CARINÆ (η ARGUS).—The study of the spectrum of the well-known variable η Carinæ, or as perhaps known better under the name of η Argus, has been undertaken by numerous workers, but the latest research on this star forms No. 252 of the Lick Observatory Bulletin, and is contributed by Messrs. J. H. Moore and R. F. Sanford. The spectrograms here described and studied were secured with the one-prism spectrograph of the D. O. Mills Expedition, at Santiago, Chili. The iron arc was used as a comparison spectrum, and the spectrograph was provided with a constant temperature case. The authors reproduce a plate showing the spectrum secured on March 28, 1913, and give tables of wave-length determinations, with comparisons with the chromosphere, laboratory spectra, and Nova Aurigæ. A brief summary of their results is as follows:—The spectrum is essentially a bright-line spectrum, a number of these lines being identified with the enhanced lines of iron, titanium, and chromium. The titanium and chromium lines show a greater displacement towards the violet than do the iron lines, the latter indicating a velocity of approach of 28 km. a second. The iron lines are in general the stronger lines, those of titanium and chromium being classed among the weaker lines. The origins of several strong lines are still unknown, and notable absentees are the lines of helium, the nebular lines, and 4481 A magnesium. Some evidence suggests the doubling of the hydrogen lines. The authors conclude that the spectrum of η Carinæ is closely associated with that of novæ at an early stage, and that possibly η Carinæ is a nova. Its position in a great nebula further supports this conclusion.

SCOTTISH FISHERY INVESTIGATIONS.[1]

"THE Fifth Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters" is the last of a series of reports, issued by H.M. Stationery Office during recent years, which have contained the detailed accounts of work done in this country in connection with the international fishery investigations. The whole series appearing under the above general title comprises five Blue-books dealing with the northern area (Cd. 2612, 3358, 4350, 4893, and 6950), where the work has been carried out by the Fishery Board for Scotland, and five dealing with the southern area (Cd. 2670, 3837, 4641, 5546, and 6125), where the work was done by the Marine Biological Association of the United Kingdom. Other reports dealing with the English statistical side of the international work have been published by the Board of Agriculture and Fisheries (Cd. 4227, 4738, 5362, and 5686).

In the introductory statement to the volume under review the Scottish Fishery Board announces that the results of future investigations will find publication among the Board's ordinary scientific reports. As the southern work is now entirely conducted by the Board of Agriculture and Fisheries, it is to be presumed that the reports dealing with it will be issued in a similar way by that Board. It may therefore be hoped that this change in the mode of publication marks the establishment of the investigations upon a permanent footing instead of their being regarded as merely temporary as heretofore. From the commencement it has been obvious that such work could only accomplish its full purpose when continued over a long series of years, and the Scottish Fishery Board, and especially Prof. D'Arcy Thompson, its scientific member, under whose superintendence the northern investigations have been carried out, are to be congratulated not only upon the completion of the five volumes of the present series of reports, but still more upon the future prospects of the undertaking.

The first four volumes issued under the direction of the Scottish Board dealt chiefly with hydrographical and statistical researches. In this fifth report, in addition to these subjects, we have accounts of some of the results of the more biological investigations carried out by the research steamer *Goldseeker*. Prof. D'Arcy Thompson is responsible for the first memoir, in which he deals chiefly with the sizes and the distribution of plaice on the basis of the hauls of the research steamer and on the Aberdeen market statistics. A further report on the plaice and other flat fishes, by Dr. T. W. Fulton, based on special statistics of individual catches of Aberdeen trawlers extending over a period of ten years (1901–10) treats of the distribution and seasonal abundance of these fishes in the different areas of the North Sea fished by the trawlers. Dr. Fulton also divides the statistics into two periods of five years, 1901–5 and 1906–10, and contrasts the quantities of field yielded in a hundred hours' fishing in the first and second periods. It is shown that in the case of plaice the weight landed per unit of fishing is less in the second period than in the first, but that whilst this decrease is marked in the case of large and medium-sized fish, there is an actual increase in the weight of small plaice landed during the second period as compared with the first.

The same feature is also brought out by the Aberdeen market statistics for the years 1905–11, which show a progressive decrease in the average catch per voyage of large and medium plaice, but a progressive increase in the catch of small. In dealing with the question of the increased landing of very small plaice, Prof. D'Arcy Thompson expresses the opinion that their destruction is detrimental to the fishery, and that it yields no commensurate benefit to the trade, a view which supports the recommendation of Prof. Heincke, which will come under the consideration of the International Council, that an international size limit of 10 in. should be enforced for plaice.

A second memoir by Dr. Fulton deals with the plaice-marking experiments. Unfortunately the number of fish marked in Scottish waters has not been large; indeed, it has not been sufficiently large to give results of a very definite kind. There can be no doubt that such experiments, when carried out upon a sufficiently extensive scale, are capable of yielding information of quite exceptional value, and we are glad to learn from the Board's introductory statement that since the period covered by the experiments here dealt with, others have been conducted upon a much larger scale.

The volume concludes with a memoir by Dr. A. J. Robertson on the hydrographical investigations for 1909–10. No new features of a striking character were found during the two years dealt with, but the work has now been carried on over a sufficient period to show what is the ordinary, normal distribution of salinities and temperatures in the area dealt with, and a useful summary of these conditions is given.

E. J. A.

[1] Fishery Board for Scotland. Fifth Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1908–11. Cd. 6950.

THIRTEEN YEARS' MEASUREMENTS OF SOLAR RADIATION.

IN a paper entitled "Valeurs Pyrheliométriques et les sommes d'insolation à Varsovie," Dr. Ladislas Gorczynski discusses the measurements which he has made at Warsaw with actinometers and pyrheliometers during the thirteen years 1901–1913. The results are to some extent of a provisional character, and they have been published chiefly with a view of assisting the Commission on Solar Radiation in its inquiry into the exceptional character of the latter half of the year 1912. During that period the intensity of solar radiation appeared generally to be considerably below the values previously found; the decrease was indeed so marked that it could be detected in the records from the Campbell-Stokes instrument which is designed primarily for the registration of duration of sunshine. The diminution has been attributed to the presence in the atmosphere of an exceptional amount of fine dust arising from the volcanic eruption of Katmai, in Alaska, at the end of June, 1912.

An ingenious explanation of the way in which the dust may stop the solar radiation without keeping in the earth's radiation to anything like the same degree has been put forward by Humphreys, in the Bulletin of the Mount Weather Observatory. The particles of dust have a diameter almost certainly greater than the wave-lengths of the most intense solar radiation, and smaller than the wave-lengths of terrestrial or atmospheric radiation, so that they would reflect the former but merely scatter the latter; and Humphrey's calculations show that the reflection would be much more effective than the scattering. Thus the effect on the temperature at the earth's surface is the reverse of that due to an increase in the *absorbing* power of the atmosphere, such as would be produced by increasing the water vapour or carbon dioxide in it. The theory is both novel and important; it indicates a method by which purely terrestrial agencies may profoundly affect the mean temperature of the globe, which may be sufficient justification for this digression.

The measurements at Warsaw bear out those found at other places; the intensity of radiation was slightly above the average for the earlier months of 1912, but from July to the end of the year it was nearly 20 per cent. below the average. The amount of the deficiency decreased in the first three months of 1913. and thenceforward the radiation appears to have been about normal. The latest values given are those for July, 1913.

The only other year in the period during which the records show a deficiency comparable with that for 1912 was 1903 (and the last two months of 1902), after the eruptions of Mont Pelée, Santa Maria, and Colima. It will be remembered that 1903 was a year remarkable in this country for its excessive rainfall and its disturbance of meteorological statistics and theories of periodicity.

The results of the whole series of measurements are discussed very fully for different altitudes of the sun, different times of day, and different conditions of the atmosphere, especially as regards humidity. The main text is in Polish, but the headings of the tables are given also in French, and there is a summary in French at the end of the paper.

E. GOLD.

AMERICAN RESEARCH ON CLAYS.[1]

A CONSIDERABLE amount of interesting work in connection with clays and the clay industries has been done in recent years in Germany and in America, and no one has worked more enthusiastically than Messrs. Ashley and Bleininger. In Germany, too, Drs. Rieke and Endell are doing really fine work. The untimely death of the writer of the first-named pamphlet—Mr. H. E. Ashley—was a sad loss which must have considerably retarded subsequent developments. The clay industries the world over owe the Bureau of Standards, etc., in the United States a debt of gratitude for having set aside such men as Messrs. Ashley and Bleininger to devote their whole time to this work, and the results must be a source of satisfaction to the authorities responsible for the innovation.

The posthumous pamphlet by Mr. Ashley, together with his "The Colloidal Matter of Clay and its Measurement" (1909), form a kind of monograph, or rather a brief advocating the colloidal theory as an explanation of the many curious properties of clays. Mr. Ashley was an extremist, and in consequence we have here probably the best possible statement of the theory without those doubts and difficulties which perplex and hamper less enthusiastic temperaments. For that reason, Mr. Ashley's brief is particularly valuable, even though it is certain that some of the applications of the colloidal theory will not be able to stand, in their present form, before adverse criticism.

The colloidal theory has been mainly directed to explaining the plasticity of clays. The argument appears to run somewhat as follows:—The plasticity of clays is determined by the contained colloidal matter (and also by the degree of fineness of the constituent particles of the clay). The greater the plasticity, the greater the proportion of colloids. Colloids are always present in clays in unknown quantities, and the proportion of colloids in clays of different plasticity varies in accord with theoretical requirements! The amount of colloidal matter in a clay is assumed to be proportional to the dye-absorptive power of the clay, and this, in turn, is stated to be proportional to the plasticity.

As a matter of fact, the real plasticity of a clay is not so easily measured. The potter's thumb is the ultimate test, and any process of measurement must express by number those complex sensations which the potter "feels" when he estimates the plasticity of a clay. If measurements of the dye-absorptive power and of the fineness of the grain of a clay will do this, then the problem is solved in a most simple and interesting manner. Unfortunately, the method breaks down completely in practice. Consequently, we cannot really go further than this: the known facts favour the colloidal theory as the best qualitative explanation of plasticity yet suggested, but no one has succeeded in satisfactorily demonstrating the theory quantitatively. Thus we return to the view held by a writer in the eighteenth century, who stated that "the plasticity is due to the presence of a greasy medium between the particles of the clay." It is difficult to see how the plasticity of clays can be measured unless it be treated as a mechanical problem; and to the present writer, Zschokke's analysis of plasticity is far and away the greatest advance that has yet been made.

The two other pamphlets seem to be an application to American clays of some ideas suggested by the present writer in several papers a few years ago: "On the Speed of Vitrification of Clays," etc. Clays are made up of a heterogeneous mixture of particles of different sizes and composition; when clay products—bricks, etc.—are being fired, the more refractory particles start dissolving in the matrix formed by those which melt first. In the extreme case, the whole would form a homogeneous vitreous mass. The firing is stopped before this condition is reached. The stage at which the process of vitrification is arrested is determined by the nature of the required products—porcelain, firebricks, etc.—and on the character of the particular clay "body" being used. Each clay has its own specific character, and this explains how a fireman with no sound principles to guide him—but a triumph of empiricism with one, or maybe two, types of clay—often fails ignominously when he is transferred from one district to another, using a different type of clay.

J. W. MELLOR.

[1] H. E. Ashley, Technical Control of the Colloidal Matter of Clays; G. H. Brown, The Function of Time in the Vitrification of Clays; A. V. Bleininger and E. T. Montgomery, Effect of Overfiring upon the Structure of Clays. Three Technological Papers of the Bureau of Standards. (Washington, D.C., U.S.A., 1913.)

FLUID MOTIONS.[1]

It is apparent that in dealing with a large and interesting class of fluid motions we cannot go far without including fluid friction, or viscosity as it is generally called, in order to distinguish it from the very different sort of friction encountered by solids, unless well lubricated. In order to define it, we may consider the simplest case where fluid is included between two parallel walls, at unit distance apart, which move steadily, each in its own plane, with velocities which differ by unity. On the supposition that the fluid also moves in plane strata, the viscosity is measured by the tangential force per unit of area exercised by each stratum upon its neighbours. When we are concerned with internal motions only, we have to do rather with the so-called "kinematic viscosity," found by dividing the quantity above defined by the density of the fluid. On this system the viscosity of water is much *less* than that of air.

Viscosity varies with temperature; and it is well to remember that the viscosity of air increases while that of water decreases as the temperature rises. Also that the viscosity of water may be greatly increased by admixture with alcohol. I used these methods in 1879 during investigations respecting the influence of viscosity upon the behaviour of such fluid jets as are sensitive to sound and vibration.

Experimentally the simplest case of motion in which viscosity is paramount is the flow of fluid through capillary tubes. The laws of such motion are simple, and were well investigated by Poiseuille. This is the method employed in practice to determine viscosities. The apparatus before you is arranged to show the diminution of viscosity with rising temperature. In the cold the flow of water through the capillary tube is slow, and it requires sixty seconds to fill a small measuring vessel. When, however, the tube is heated by passing steam through the jacket surrounding it, the flow under the same head is much increased, and the measure is filled in twenty-six seconds. Another case of great practical importance, where viscosity is the leading consideration, relates to lubrication. In admirably conducted experiments Tower showed that the solid surfaces moving over one another should be separated by a complete film of oil, and that when this is attended to there is no wear. On this basis a fairly complete theory of lubrication has been developed, mainly by O. Reynolds. But the capillary nature of the fluid also enters to some extent, and it is not yet certain that the whole character of a lubricant can be expressed even in terms of both surface tension and viscosity.

It appears that in the extreme cases, when viscosity can be neglected and again when it is paramount, we are able to give a pretty good account of what passes. It is in the intermediate region, where both inertia and viscosity are of influence, that the difficulty is greatest. But even here we are not wholly without guidance. There is a general law, called the law of dynamical similarity, which is often of great service. In the past this law has been unaccountably neglected, and not only in the present field. It allows us to infer what will happen upon one scale of operations from what has been observed at another. On the present occasion I must limit myself to viscous fluids, for which the law of similarity was laid down in all its completeness by Stokes so long ago as 1850. It appears that similar motions may take place provided a certain condition be satisfied, viz., that the product of the linear dimension and the velocity, divided by the kinematic viscosity of the fluid, remain unchanged. Geometrical similarity is presupposed. An example will make this clearer. If we are dealing with a single fluid, say air under given conditions, the kinematic viscosity remains of course the same. When a solid sphere moves uniformly through air, the character of the motion of the fluid round it may depend upon the size of the sphere and upon the velocity with which it travels. But we may infer that the motions remain *similar*, if only the product of diameter and velocity be given. Thus, if we know the motion for a particular diameter and velocity of the sphere, we can infer what it will be when the velocity is halved and the diameter doubled. The fluid velocities also will everywhere be halved at the *corresponding* places. M. Eiffel found that for any sphere there is a velocity which may be regarded as critical, *i.e.* a velocity at which the law of resistance changes its character somewhat suddenly. It follows from the rule that these critical velocities should be inversely proportional to the diameters of the spheres, a conclusion in pretty good agreement with M. Eiffel's observations.[2] But the principle is at least equally important in effecting a comparison between different fluids. If we know what happens on a certain scale and at a certain velocity in *water*, we can infer what will happen in *air* on any other scale, provided the velocity is chosen suitably. It is assumed here that the compressibility of the air does not come into account, an assumption which is admissible so long as the velocities are small in comparison with that of sound.

But although the principle of similarity is well established on the theoretical side and has met with some confirmation in experiment, there has been much hesitation in applying it, due perhaps to certain discrepancies with observation which stand recorded. And there is another reason. It is rather difficult to understand how viscosity can play so large a part as it seems to do, especially when we introduce numbers, which make it appear that the viscosity of air, or water, is very small in relation to the other data occurring in practice. In order to remove these doubts it is very desirable to experiment with different viscosities, but this is not easy to do on a moderately large scale, as in the wind channels used for aeronautical purposes. I am therefore desirous of bringing before you some observations that I have recently made with very simple apparatus.

When liquid flows from one reservoir to another through a channel in which there is a contracted place, we can compare what we may call the *head* or driving pressure, *i.e.* the difference of the pressures in the two reservoirs, with the *suction*, *i.e.* the difference between the pressure in the recipient vessel and that lesser pressure to be found at the narrow place. The ratio of head to suction is a purely numerical quantity, and according to the principle of similarity it should for a given channel remain unchanged, provided the velocity be taken proportional to the kinematic viscosity of the fluid. The use of the same material channel throughout has the advantage that no question can arise as to geometrical similarity, which in principle should extend to any roughness upon the surface, while the necessary changes of velocity are easily attained by altering the head and those of viscosity by altering the temperature.

The apparatus consisted of two aspirator bottles (Fig. 1) containing water and connected below by a passage bored in a cylinder of lead, 7 cm. long, fitted water-tight with rubber corks. The form of channel actually employed is shown in Fig. 2. On the up-stream side it contracts pretty suddenly from full bore (8 mm.) to the narrowest place, where the diameter is 2·75 mm. On the down-stream side the

[1] From a discourse delivered at the Royal Institution on March 20 by the Right Hon. Lord Rayleigh, O.M., F.R.S.

[2] *Comptes rendus*, December 30, 1912, January 13, 1913.

expansion takes place in four or five steps, corresponding to the drills available. It had at first been intended to use a smooth curve, but preliminary trials showed that this was unnecessary, and the expansion by steps has the advantage of bringing before the mind the dragging action of the jets upon the thin layers of fluid between them and the walls. The three pressures concerned are indicated on manometer tubes as shown, and the two differences of level representing head and suction can be taken off with compasses and referred to a millimetre scale. In starting an observation the water is drawn up in the discharge vessel, so far as may be required, with the aid of an air-pump. The rubber cork at the top of the discharge vessel necessary for this purpose is not shown.

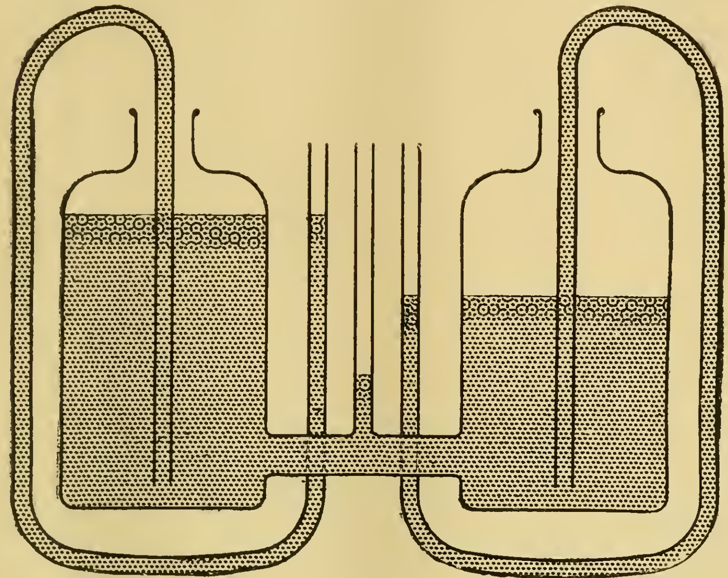


FIG. 1.

As the head falls during the flow of the water, the ratio of head to suction increases. For most of the observations I contented myself with recording the head for which the ratio of head to suction was exactly 2 : 1, as indicated by proportional compasses. Thus on January 23, when the temperature of the water was 9° C., the 2 : 1 ratio occurred on four trials at 120, 130, 123, 126, mean 125 mm. head. The temperature was then raised with precaution by pouring in warm water with passages backwards and forwards. The occurrence of the 2 : 1 ratio was now much retarded, the mean head being only 35 mm., corresponding to a mean temperature of 37° C. The ratio of head to suction is thus dependent upon the head or velocity, but when the velocity is altered the original ratio may be recovered if at the same time we make a suitable alteration of viscosity.

And the required alteration of viscosity is about what might have been expected. From Landolt's tables I find that for 9° C. the viscosity of water is 0·01368, while for 37° C. it is 0·00704. The ratio of viscosities is accordingly 1·943. The ratio of heads is 125 : 35. The ratio of *velocities* is the square-root of this, or 1·890, in sufficiently good agreement with the ratio of viscosities.

In some other trials the ratio of velocities *exceeded* a little the ratio of viscosities. It is not pretended that the method would be an accurate one for the comparison of viscosities. The change in the ratio of head to suction is rather slow, and the measurement is usually somewhat prejudiced by unsteadiness in the suction manometer. Possibly better results would be obtained in more elaborate observations by several persons, the head and suction being recorded separately and referred to a time scale so as to facilitate interpolation. But as they stand the results suffice for my purpose, showing directly and conclusively the influence of viscosity as compensating a change in the velocity.

In conclusion, I must touch briefly upon a part of the subject where theory is still at fault, and I will limit myself to the simplest case of all—the uniform shearing motion of a viscous fluid between two parallel walls, one of which is at rest, while the other moves tangentially with uniform velocity. It is easy to prove that a uniform shearing motion of the fluid satisfies the dynamical equations, but the question remains : Is this motion stable? Does a small departure from the simple motion tend of itself to die out? In the case where the viscosity is relatively great, observation suggests an affirmative answer; and O. Reynolds, whose illness and comparatively early death were so great a loss to science, was able to deduce the same conclusion from theory. Reynolds's method has been improved, more especially by Prof. Orr of Dublin. The simple motion is thoroughly stable if the viscosity exceed a certain specified value relative to the velocity of the moving plane and the distance between the planes; while if the viscosity is less than this, it is possible to propose a kind of departure from the original motion which will increase *for a time*. It is on this side of the question that there is a deficiency. When the viscosity is very small, observation appears to show that the simple motion is unstable, and we ought to be able to derive this result from theory. But even if we omit viscosity altogether, it does not appear possible to prove instability *a priori*, at least so long as we regard the walls as mathematically plane. We must confess that at the present we are unable to give a satisfactory account of skin-friction, in order to overcome which millions of horse-power are expended in our ships. Even in the older subjects there are plenty of problems left!

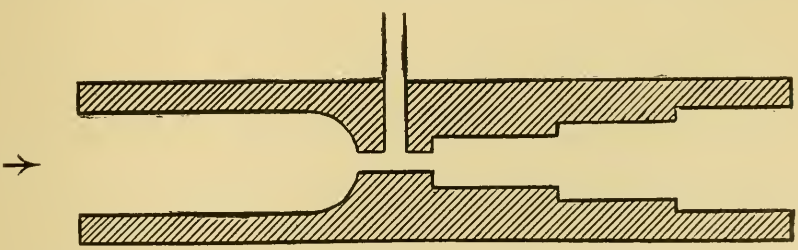
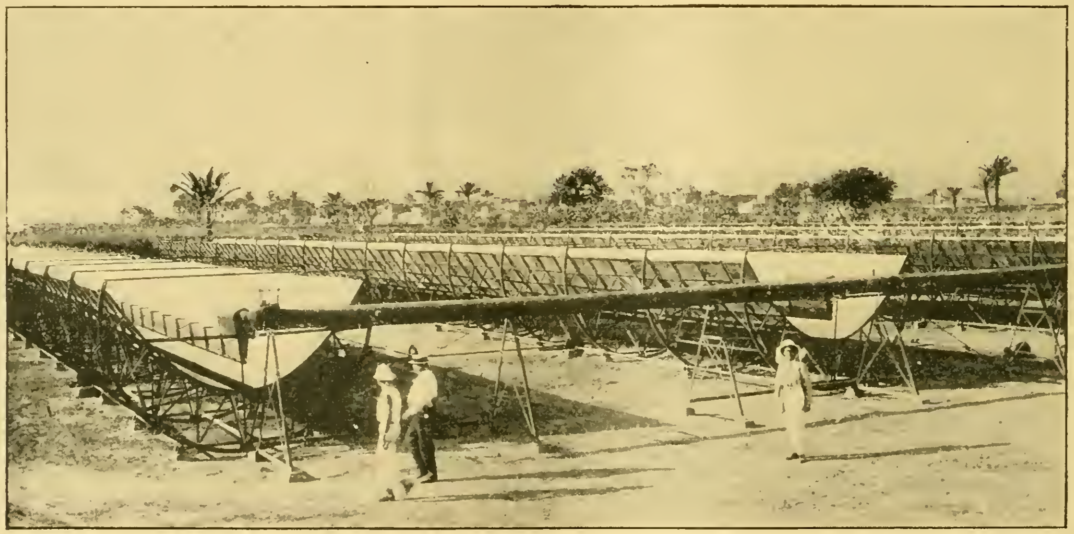


FIG. 2.

THE UTILISATION OF SOLAR ENERGY.[1]

AFTER naming the principal workers in this field, the author gives determinations of the solar constant and deals fully with the varying percentages of this quantity that are available throughout the day for power purposes. He then describes four types of Shuman sun heat absorbers and gives in great detail the results of his forty-eight trials of these absorbers, the latest pattern (that erected near Cairo, Egypt) of which gave a maximum thermal efficiency of no less than 40·7 per cent., and a maximum output of steam of 1442 lb. an hour at a pressure of 15·8 lb. per sq. in. abs. The results of these types of absorbers are compared by means of tables and curves, and from these the author has constructed a formula by means of which it is easy to calculate for a given type and size of absorber the total output of steam an hour if three things are known: (1) the time of day; (2) the humidity; and (3) the steam pressure. It has been known that humidity adversely affects the quantity of solar radiation arriving at the earth's solid surface, but this is the first time that its effect on solar steam production has been quantitatively determined.



The Meadi Absorber. Looking N.E. and showing the reflectors in the mid-day position. There are 5 reflectors each 205 ft. long, and 13 ft. 5 in. wide at the top.

The difference between the thermal efficiency of the solar boiler and the commercial value of the steam produced is ingeniously brought out, the author making it clear that in the case of such low-pressure boilers a high thermal efficiency is not necessarily the same thing as the most economical conditions of working, and he shows that, up to a certain limit, the higher the steam pressure, the more economical the working, though the thermal efficiency is then lower. Two of the types of absorber did not move with the sun, and one did. The greater constancy of output of steam in the case of the latter is very marked.

In order to utilise the low-pressure steam economically, Mr. Frank Shuman designed a special engine which has also gone through several stages. This engine is fully described with drawings, and the author gives the results of his fourteen trials of the several engines and compares their results with those of exhaust steam turbines and the low-pressure cylinders of compound- and triple-expansion engines, showing that the Shuman engine is the more economical. The steam consumption of one of these engines was only 22·1 lb. per B.H.P. hour, when the output was 94·5 B.H.P., and the steam pressure only 16·2 lb. per sq. in. abs. The thermal efficiency of the engine compared with an engine working on the Rankine cycle was 54·75 per cent. In the case of a Shuman high-pressure non-condensing engine with an output of 29 B.H.P., the steam consumption was 23·8 lb. per B.H.P. hour, and the relative thermal efficiency 71·7 per cent.

Finally the author gives the results of his trials of the complete sun power irrigation plant at Cairo, and describes his design of a special form of weir tank for measuring greatly differing quantities of water.

[1] Summary of a paper read before the Society of Engineers (Incorporated) on April 6, by Mr. A. S. E. Ackermann.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. W. H. R. Rivers has been appointed to represent the University at the nineteenth International Congress of Americanists to be held at Washington, U.S.A., in October next.

The Special Board for Biology and Geology has nominated Dr. Shipley as the representative of the University on the council of the Marine Biological Association.

The Sudbury Hardyman prize offered for an original dissertation by a graduate member of Emmanuel College under the standing of M.A., has been awarded to Mr. G. Matthai, for a treatise entitled "A Revision of the Recent Colonial Astræidæ Possessing Distinct Corallites."

OXFORD.—The Halley Lecture in 1915 will be delivered by Dr. F. W. Dyson, F.R.S., late fellow of Trinity College, Cambridge, Astronomer Royal.

The Hon. Bertrand A. W. Russell, F.R.S., late fellow of Trinity College, Cambridge, has been elected Herbert Spencer lecturer for the year 1914–15.

The Romanes Lecture, as previously announced, will be delivered by Sir J. J. Thomson, O.M., F.R.S., on June 10, at 3 o'clock. Subject, "The Atomic Theory."

DR. C. W. CHAMBERLAIN has been inaugurated president of Denison University, Ohio. From 1901 to 1908 Dr. Chamberlain occupied the chair of physics in that institution. Since the latter date he has held the professorship of that subject in Vassar College.

DR. B. T. GALLOWAY has resigned his position as assistant secretary of the U.S. Department of Agriculture in order to accept the post of dean of the Agricultural College of Cornell University.

THE London County Council Education Committee has had under review the scheme for the reorganisation of the council's evening school system which was adopted last winter. The object of the reorganisation was to remedy certain serious defects of enrolment, attendance, and organisation, and to infuse freshness and attractiveness into the system. Among other arrangements made was a relief from fees as an award for good attendance, important changes in the *personnel* and duties of the inspectorate, and changes of a far-reaching character in the staffing, so as ultimately to obtain a separate staff for evening schools. Public attention was at the beginning of the session directed to the classes in many ways. Though a decrease of 30,000 pupils was anticipated in the total attendance, happily this was not realised. The committee is of opinion that in the main no change in the fundamental principles of the organisation appears to be advisable. Extension of the main features of the organisation are recommended, and some modifications of detail are suggested. It is proposed in a few instances to convert free schools into fee-paying under the ordinary conditions. The most important proposal, however, is to charge a registration fee of sixpence at all "free" institutes. It is felt that the immediate outlay of sixpence on joining an institute will be some guarantee that the student is serious, while it will not really interfere with the "free" character of the schools. The committee proposes to make provision for 120,000 students in these classes next year.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, May 19.—Mr. R. H. Burne, vice-president, in the chair.—Dr. C. H. **O'Donoghue**: The venous system of the dogfish. The general disposition of the main trunks in Scyllium is similar to that described in other Elasmobranchs, but the details differ considerably.—B. F. **Cummings**: Scent-organs in Trichoptera. An account of the remarkable development of the palpi of the first maxilla in a male caddis-fly, *Sericostoma personatum*. Instead of being 5-segmented, the palpus consists of a single swollen segment carrying an enormous tuft of long, silky hairs, at the bases of which unicellular scent-glands are situated.—H. A. **Baylis**: A new species of Cestode collected from an albatross (*Diomedea irrorata*) by Dr. H. O. Forbes in Peru.—D. M. S. **Watson**: The Deinocephalia, an order of mammal-like reptiles. The skull of a Tapinocephaloid is almost completely described. The fact that whilst in the skull Deinocephalia agree with the American Pelycosaurs, but in the post-cranial skeleton they resemble South African Therapsids, shows that the American forms must be included in the same great group, super-order, as the South African mammal-like reptiles.—Dr. R. C. L. **Perkins**: Species of the genus Paralastor and some other Hymenoptera of the family Eumenidæ. All the described species are enumerated therein, together with the descriptions of many new forms.—G. **Jennison**: Notes on colour-development in the Indian wood-stork (*Pseudotantalus leucocephalus*).—Dr. Ph. **Lehrs**: A new lizard from the Canary Islands, recently discovered by Dr. Cæsar Boettger on Hierro.

Physical Society, May 22.—Dr. A. Russell, vice-president, in the chair.—T. **Barratt** and A. B. **Wood**: Volatility of thorium active deposit. On heating thorium active deposit to accurately measured temperatures up to about 1250° C. it is found that B and C each commence to volatilise at 750° C., but the volatilisation is not complete until 1200° C. is reached. The C curve is peculiar, being similar to two of the B curves placed end to end, the inflexion occurring between 750° C. and 900° C., where about 35 per cent. of the α activity is removed. When measured by β radiation, C is not volatile until a temperature of 900° C. is reached. D commences to volatilise at 500° C. It is assumed that the part of C which produces β rays, viz., C_β, is a separate product, which is not so readily volatile as C_α.—H. P. **Walmsley** and Dr. W. **Makower**: The passage of α particles through photographic films. Kinoshita has shown that when an α particle strikes a grain of silver halide, that grain is subsequently capable of photographic development. It seemed probable that the path of an α particle projected tangentially to a photographic film should, after development, be visible under a microscope. This was shown to be the case, and photomicrographs showing the tracks of α particles through a photographic plate have been obtained.—S. **Butterworth**: A null method of testing vibration galvanometers. By extending the theory of the vibration galvanometer it is shown how the constants may be determined by methods which involve only the measurements of one deflection. The remaining measurements are carried out on an alternating-current bridge. The principle of the method depends on the fact that a vibration galvanometer behaves as a parallel combination of a conductance, a capacity and an inductance, in series with a resistance.—C. W. S. **Crawley** and Dr. S. W. J. **Smith**: Experiments with an incandescent lamp. The first experiment was due to Mr. Addenbrooke who, using a 100-volt lamp filled with paraffin oil as a high resistance in a 200-volt circuit, noticed that some of the bubbles forming on the filament behaved in a curious way. Instead of rising at once to the surface they ran down the legs of the filament, against gravity, and escaped at the leading-in wires. Dr. Smith, repeating the experiment, discovered another striking phenomenon. Placing the 100-volt lamp in a 100-volt circuit in series with a variable resistance it was found possible to obtain a single bubble upon the wire. Instead of escaping at either terminal, the bubble travels backwards and forwards between the two, "looping the loops" of the filament during every journey. A rapid fall of temperature from the wire through the liquid, in the region through which the bubble moves, is an essential condition of the phenomenon.

DUBLIN.

Royal Dublin Society, May 26.—Prof. W. Brown in the chair.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1913. The more noteworthy records are larvæ of Bibionidæ feeding in potato tubers, and the presence of all three species of apple Aphis—*A. pomi, A. sorbi*, and *A. fitchi*—in Ireland. Observations and experiments by T. R. Hewitt on the infestation of narcissus bulbs by eelworms (Tylenchus) and their migration through the soil are described. Copper sulphate in weak solution (5–7½ per cent.) is safe and effective for soaking the bulbs. A mature larva of Hypoderma extracted from the back of a mare may be confidently referred to the common *H. bovis*.—T. R. **Hewitt**: The larva and puparium of the frit-fly. The author describes the external features of this destructive larva in greater detail than has yet been attempted, directing attention to sensory organs in the head region, the mouth hooks, and the spiracles.—Prof. J. **Wilson**: Polygamous Mendelian factors. In papers on the colours of horses published in 1910 (Roy. Dublin Soc. Proc., vol. xii., p. 331) and 1912 (*ibid.*, vol. xiii., p. 184) it was observed that each of the colours was the result of a single factor which was polygamous. That is to say, the factor for one colour can mate with the factor for any of the others, one at a time. When the observation was made, however, it was not realised to be unusual or extraordinary, but was assumed to be a phenomenon which might occur frequently; consequently stress was not laid upon the observation. It was eventually seen, however, that the phenomenon is very unusual, and with the data collected, together with additional data to be found in Dr. Walther's "Beiträge zur Kenntniss der Vererbung der Pferdefarben," the phenomenon is now demonstrated. It would be inferred from Dr. Walther's data if the "absences" which his analysis requires were eliminated, and the conditions which they stand for substituted in their stead.

Paris.

Academy of Sciences, May 18.—M. P. Appell in the chair.—Armand **Gautier** and P. **Clausmann**: Fluorine in freshwater. An application of the method previously described for determining traces of fluorine to the examination of water from rivers, glaciers, and springs. No potable waters examined contain more than 0·6 milligram of fluorine per litre. In Paris water the amount of fluorine taken a day per individual is about 0·12 mgr., or less than a quarter the amount daily excreted.—Charles **Moureu** and Georges **Mignonac**: A new class of nitrogen compounds, the ketisoketimines. This name is applied to substances of the type R.CR′ : N.CR : CH.R″, obtained by the action of heat upon the ketimines.—L. **Maquenne** and E. **Demoussy**: The mobility of potash in plant tissues. —J. **Delauney**: The times of revolution of the satellites of a given system presenting certain relations between themselves.—W. **Goloubeff**: Functions with discontinuous singularities.—Marcel **Moulin**: The position of the centre of gravity of spiral springs furnished with theoretical terminal curves.—Albert **Turpain**: A photographic self-recording microammeter and the measurement which it furnishes. The apparatus described has given good records of messages from the Eiffel Tower at Poitiers, 300 km. distant. The instrument is of use in geodesic operations.—G. Gouré de **Villemontée**: The propagation of electricity through paraffin oil.—Léon and Eugène **Bloch**: The spark spectra of some elements in the extreme ultra-violet. Wave-lengths are given of the lines for arsenic, antimony, tin, bismuth, aluminium, and cadmium for the range 2134 to 1855.—R. **Marcelin**: The evaporation of slightly superheated liquids and solids. Results are given for nitrobenzene, naphthalene, and iodine.—Léo **Vignon**: The solvents of coal. Coals of different origin were extracted with alcohol, ether, benzene, toluene, aniline, nitrobenzene, pyridine, and quinoline. The soluble and insoluble portions of the coals were analysed. Bituminous coals gave a high aniline extract.—J. **Bougault**: The process of saponification of esters and of amides by strong sulphuric acid.—Georges **Tanret**: The constitution of galegine. This alkaloid was extracted from the seeds of *Galega officinalis*, and has the composition $C_6H_{13}N_3$. Its most important reaction is the formation of methyl-3-pyrrolidine and urea by hydrolysis with baryta water.—E. **Carrière**. The equilibrium at the ordinary temperature of the enol and aldehyde forms of ethyl formylsuccinate and ethyl formylethylsuccinate.—R. **Fosse**: The chemical activity of xanthydrol and its application to the estimation of urea.—Robert **Douin**: The development of the fruit-bearing apparatus of Marchantia.—M. **Marage**: The sensibility of the physiological ear for certain musical sounds.—A. **Moutier**: The interdependence of peripheral arterial hypotension and visceral arterial hypertension.—A. **Trillat** and M. **Fouassier**: The action of cooling on microbial droplets. —J. **Nageotte**: Some peculiarities of the nerve fibre of batrachians and on the so-called alterations of the myeline sheath, considered as causing changes of excitability of the nerves.—M. **Vasticar**: The nuclear formations of the internal auditive cell.—Mme. Marie **Phisalix**: Poisonous properties of the parotidian saliva of *Coronella austriaca*.—L. **Germain** and L. **Joubin**: The Chetognaths of the cruises of the Prince of Monaco.—Gabriel **Bertrand** and M. **Rosenblatt**: The thermo-regeneration of sucrase. A study of the changes in the hydrolysing power of sucrase from yeast produced by exposure to varying temperatures. —F. **Kerforne**: The presence of *Calymmene blumenbachi* in the Gothlandian of Brittany.—N. **Arabu**: The Trias of Ismid.—Léon **Bertrand** and Antonin **Lanquine**: New observations on the tectonic of the south-west slopes of the Maritime Alps.—E. A. **Martel**: The chasms of the Tertiary formations in the neighbourhood of Vertus (Marne).—Alphonse **Berget**: A piezometric sounder. Use is made of the compressibility of water contained in a tube silvered internally. The water is in contact with mercury, and the contraction of the water is measured by the amount of the silver removed as amalgam. The sensibility is practically constant at increasing depths, and gives an accuracy of 10 metres at a depth of about 6000 metres.—Ernest **Esclangon**: An instrument for recording the intensity of rainfalls.—Gabriel **Guilbert**: Weather prediction.

May 25.—M. P. Appell in the chair.—Fred. **Wallerant**: Contribution to the study of polymorphism. Experimental details concerning the polymorphism of malonic acid, monochlorocamphor, benzyl cinnamate, benzaldoxim, paratolylphenylketone and trinitrometacresol.—S. A. S. **Albert**, Prince of Monaco: The third campaign of *Hirondelle II.* (twenty-sixth of the complete series). In the course of bathypelagic work it has been found that certain organisms, more especially fishes, are only found during the daytime at a depth not less than 1000 metres, but are commonly obtained during the night at a depth of 200 metres. This corresponds to a change of pressure of 100 atmospheres.—M. Jacques **Loeb** was elected a correspondant for the section of anatomy and zoology in the place of the late Lord Avebury.—A. **Schaumasse**: Observations of the Zlatinsky comet (1914*b*) made with the equatorial at the Nice Observatory. Data given for May 18, 19, 20, 21, 22, 23. Changed from 6th magnitude on May 18 to 8·7 magnitude four days later.—Louis **Fabry**: The problem of the minor planets.—P. **Chofardet**: Observations of the new comet 1914*b* (Zlatinsky) made at the Observatory of Besançon. Four positions given for May 19–22. Was estimated to be of the 5th magnitude on May 19.—L. **Ballif**: The surfaces developed in two different manners by the motion of an indeformable curve.—W. de **Tannenberg**: A functional equation and curves of constant torsion.—T. H. **Gronwall**: Laplace's series.—R. W. **Wood** and L. **Dunoyer**: The optical resonance of sodium vapour under the stimulation of one only of the D lines. It has been proved that the resonance radiation excited by the line D_2 alone contains that radiation only.—A. **Blanc**: A radiation accompanying the oxidation of phosphorus. The oxidation of phosphorus is accompanied by the production of an ionising radiation of very slight penetrating power, and resembling the γ rays of radio-active substances.—M. de **Broglie**: The spectroscopy of the secondary rays emitted outside Röntgen tubes and the absorption spectra.—L. **Bouchet**: A manometric arrangement for studying very small deformations of indiarubber.—Ch. **Fabry** and H. **Buisson**: The experimental verification of the Doppler-Fizeau principle.—R. **Swyngedauw**: The control of the insulation of a triphase network.—Ernest **Berger**: The oxidation of copper: the influence of temperature and pressure. The oxidation of copper by dry oxygen can be traced down to a temperature of 15° C. The velocity of oxidation is tripled for each 10° rise of temperature.—Jules **Roux**: Study of the limit of some reactions by means of the hydrostatic balance. Examples of the application of a quartz float to determine small changes of density.—Victor **Henri** and Venceslas **Moycho**: The action of monochromatic ultra-violet rays on the tissues. Measurement of the energy of radiation corresponding to sunstroke.—G. **Courtois**: Some organic uranium salts of the monoacids of the fatty series.—P. **Lebeau** and M. **Picon**: The hydrogenation of the cyclic hydrocarbons by sodammonium. The preparation of naphthalene tetrahydride. Naphthalene and powdered sodium are treated with liquid ammonia, naphthalene tetrahydride, and sodium amide are produced.—G. **André**: The development of the bud in a living plant (chestnut).—W. **Kopaczewski**: Researches on the composition of *Scilla maritima*. A toxic glucoside, not containing nitrogen, has been isolated from the scilla.—Raoul **Bayeux** and Paul **Chevallier**: Comparative researches on the concentration of the arterial blood and venous blood at Paris, Chamonix, and Mt. Blanc, by the refractometric study of the serum.—J. **Tissot**: Destruction of serum activity by heat.—Robert **Dollfus**: *Trochicola enterica*, a parasitic Eucopepod of the intestine of the Trochidæ.—M. **Herlant**: The existence of a periodic rhythm in the determination of the first phenomena of experimental parthenogenetic development in the sea-urchin (*Paracentrotus lividus*).—Ch. A. **Rolland**: Contribution to the study of the constitution of bovine vesicular bile and of its lipoid portion.—Maurice **Gignoux** and Paul **Combay**: The history of the last rhodanian glaciations in the Belley basin.—L. **Cayeux**: The existence of numerous traces of perforating algæ in French oolitic iron minerals.—H. **Fonzes-Diacon** and M. **Fabre**: The detection of boron in mineral waters.—Albert **Baldit**: A case of globular lightning.

BOOKS RECEIVED.

Western Australia. Geological Survey. Bulletin No. 44. A Geological Reconnaissance of a Portion of the South-West Division of Western Australia. By E. C. Saint-Smith. Pp. 80. Bulletin No. 49. Geology and Mineral Resources of the Yilgarn Goldfield. Part 1. Southern Cross. By E. C. Saint-Smith and R. A. Farquharson. Pp. 193+plates. (Perth, W.A.)

The Teaching of Mathematics in Australia. By Prof. H. S. Carslaw. Pp. 79. (Sydney: Angus and Robertson, Ltd.; London: Oxford University Press.)

The Call of the Stars. By Dr. J. R. Kippax. Pp. xviii+431+xliii plates. (New York and London: G. P. Putnam's Sons.) 10*s*. 6*d*. net.

Die Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. Edited by Prof. A. Pascher. Heft 6. Chlorophyceæ, III. By W. Heering. Pp. iv+250. (Jena: G. Fischer.) 6 marks.

Chimie Physique Elémentaire. By E. Ariès. Tome Premier. Pp. xxx+212. (Paris: A. Hermann et Fils.) 4 francs.

Der Bau des Weltalls. By Prof. J. Scheiner. Vierte Auflage. Pp. iv+132. (Leipzig: B. G. Teubner.) 1.25 marks.

Vegetationsbilder. Edited by Drs. G. Karsten and H. Schenck. Zwölfte Reihe. Heft 2 and 3. Pp. iv+Tafel 7–18. (Jena: G. Fischer.) 8 marks.

I.K. Therapy, with Special Reference to Tuberculosis. By Dr. W. E. M. Armstrong. Pp. x+83. (London: H. K. Lewis.) 5*s*. net.

A Contribution to the Flora and Plant Formations of Mount Kinabalu and the Highlands of British North Borneo. By L. S. Gibbs. Pp. 240+plates 1–8. (London: Linnean Society.)

The Carnegie Foundation for the Advancement of Teaching. Eighth Annual Report of the President and of the Treasurer. Pp. vi+158. (New York City.)

Annual Report of the Meteorological Observatory of the Government General of Korea for the year 1912. Pp. iv+120+20. (Chemulpo.)

Manks Antiquities. By P. M. C. Kermode and Prof. W. A. Herdman. Second edition. Pp. 150. (Liverpool University Press.) 3*s*. net.

Memorabilia Mathematica, or the Philomath's Quotation-Book. By Prof. R. E. Moritz. Pp. x+410. (London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

Twenty-sixth Annual Report of the Purdue University Agricultural Experiment Station, Lafayette, Indiana, for the Year Ending June 30, 1913. Pp. 88. (Lafayette, Ind.)

Aeronautics. Technical Report of the Advisory Committee for Aeronautics for the Year 1912–13 (with Appendices). Pp. 416. (London: H.M.S.O.; Wyman and Sons, Ltd.) 10*s*.

Spectrum Analysis Applied to Biology and Medicine. By the late Dr. C. A. MacMunn. Pp. xiv+112. (London: Longmans and Co.) 5*s*. net.

Problems of Science. By F. Enriques. Translated by K. Royce. Pp. xvi+392. (Chicago and London: Open Court Publishing Co.) 10*s*. net.

The Country Month by Month. By J. A. Owen and Prof. G. S. Boulger. New edition. Pp. x+492+plates. (London: Duckworth and Co.) 6*s*. net.

The Latest Light on Bible Lands. By P. S. P. Handcock. Second edition. Pp. xii+371. (London: S.P.C.K.) 6*s*. net.

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject Index. Vol. iii. Physics. Part ii. Electricity and Magnetism. Pp. xv+551–927+vii. (Cambridge University Press.) 15*s*. net.

Amulets Illustrated by the Egyptian Collection in University College, London. By Prof. W. M. Flinders Petrie. Pp. x+58+liv plates. (London: Constable and Co., Ltd.) 21*s*. net.

A Practical Treatise on Sub-Aqueous Foundations. By C. E. Fowler. Third edition. Pp. xliii+814. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 31*s*. 6*d*. net.

The Science of Knitting. By E. Tompkins. Pp. xiii+330. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Chemical Examination of the Blood and its Technique. By Prof. A. Pappenheim. Translated by R. Donaldson. Pp. ix+87+ii plates. (Bristol: J. Wright and Sons.) 3*s*. 6*d*. net.

The Statesman's Year-Book. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. lxxix + 1500. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

The Standard Cyclopedia of Horticulture. By L. H. Bailey. Pp. xx + 602 + xx plates. (London: Macmillan and Co., Ltd.) 25s. net.

The Institute of Chemistry of Great Britain and Ireland. Lectures on Explosives. By W. Macnab. Pp. 68. (London: 30 Bloomsbury Square.)

Twelfth Report of the Sarawak Museum, 1913. By J. C. Moulton. Pp. ii + 47. (Sarawak.)

Poems of Human Progress. By J. H. West. Pp. xii + 328. (Boston: The Tufts College Press.) 1.50 dollars net.

Preliminary Practical Science. By H. Stanley. Pp. viii + 128. (London: Methuen and Co., Ltd.) 1s. 6d.

Gearing. By A. E. Ingham. Pp. xi + 181. (London: Methuen and Co., Ltd.) 5s. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Faraday and the Foundations of Electrical Engineering: Prof. S. P. Thompson.

LINNEAN SOCIETY, at 8.—The Botanical Results of a Recent Expedition to Turkestan: Dr. B. Fedtschenko.—Darwin's Alternative Explanation of the Origin of Species *without* the Means of Natural Selection: Prof. G. Henslow.—A Collection of Land and Freshwater Gastropods from Madagascar, with Descriptions of a New Genus and New Species: G. C. Robson.—Sections showing the Entire Vertical Thickness of a Seam of Coal: J. Lomax.—Notes on the Morphology of Certain Structures concerned in Reproduction in the Genus Gnetum: Prof. H. H. W. Pearson.—Curculionidæ from the Indian Ocean. (Percy Sladen Expedition): G. C. Champion.—Deto, a Subantarctic Genus of Terrestrial Isopoda: Prof. C. Chilton.

FRIDAY, JUNE 5.

ROYAL INSTITUTION, at 9.—X-rays and Crystalline Structure: Prof. W. H. Bragg.

GEOLOGISTS' ASSOCIATION, at 8.—Prehistoric Problems in Geology: R. A. Smith.

SATURDAY, JUNE 6.

ROYAL INSTITUTION, at 3.—Studies on Expression in Art. I.: Origin and Development: Sigismund Goetze.

MONDAY, JUNE 8.

ARISTOTELIAN SOCIETY, at 8.—The Treatment of History by Philosophers: D. Morrison.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Dickson Centrifuge System of Sewage Treatment: E. H. Tripp.—Studies on the Reduction of Uranium Oxide: E. K. Rideal.—Contribution to the Discussion on Paper, Bleaching of Chemical Pulp, by Baker and Jennison, and Bleaching Efficiency considered in connection with Suggested Standard for Testing Bleaching Qualities of Chemical Wood Pulp: C. Beadle and H. P. Stevens.

INSTITUTE OF ACTUARIES, at 5.—Annual Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—The Australian Antarctic Expedition: Dr. D. Mawson.

TUESDAY, JUNE 9.

ROYAL INSTITUTION, at 3.—Celestial Spectroscopy: Prof. A. Fowler.

ZOOLOGICAL SOCIETY, at 8.30.—A Report on the Fauna of the Monte Bello Islands: P. D. Montague.—Cephalopoda from the Monte Bello Islands: G. C. Robson.—Stalk-eyed Crustaceans collected at the Monte Bello Islands: Miss M. J. Rathburn.—Report on Mollusca collected at the Monte Bello Islands: T. Iredale.—Zoological Results of the Third Tanganyika Expedition conducted by Dr. W. A. Cunnington, 1904–1905. Report on the Parasitic Eucopepoda: Dr. W. A. Cunnington.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. XIV. A New Species of Rhabdometra and on the Paruterine Organ in Otiditænia: Dr. F. E. Beddard.—The Marine Fauna of British East Africa, from Collections made by Cyril Crossland, in the Years 1901–1902: A. W. Waters.—(1) The Facial Vibrissæ of Mammals; (2) The Feet and other External Characters of the Ursidæ and Canidæ: R. I. Pocock.—*Procolophon trigoniceps*: a Cotylosaurian Reptile from South Africa: D. M. S. Watson.—A Second Collection of Batrachians and Reptiles made by Dr. H. G. F. Spurrell, in the Choco, Colombia: Dr. G. A. Boulenger.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.

WEDNESDAY, JUNE 10.

GEOLOGICAL SOCIETY, at 8.—The Geology and Glaciology of the Antarctic Regions: Dr. D. Mawson.—The Ballachulish Fold at the Head of Loch Creran (Argyllshire): E. B. Bailey.

THURSDAY, JUNE 11.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Bearing of Cytological Research on Heredity: Prof. E. B. Wilson.

ROYAL INSTITUTION, at 3.—Faraday and the Foundations of Electrical Engineering: Prof. S. P. Thompson.

FRIDAY, JUNE 12.

ROYAL INSTITUTION, at 9.—Some Aspects of the American Democracy: The Hon. W. H. Page.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—Note on the Connection between the Method of Least Squares and the Fourier Method of Calculating the Co-efficients of a Trigonometrical Series to Represent a Given Function or Series of Observations: Prof. C. H. Lees.—A Magnetograph for Measuring Variations in the Horizontal Intensity of the Earth's Magnetic Field: F. E. Smith.—The Atomic Weight of Copper by Electrolysis: A. G. Shrimpton.—Note on an Improvement in the Einthoven String Galvanometer: W. H. Apthorpe.

MALACOLOGICAL SOCIETY, at 8.—*Sulcobasis concisa*, Fer., and its Nearest Allies: C. R. Boettger.—Note on the radula and maxilla of *Orthalicus zebra*, Müller: Rev. E. W. Bowell.—(1) Invalid Molluscan Generic Names; (2) A New Cassid: T. Iredale.—The Relative Claim to Priority of the Names *Helix carduelis*, Schulze, and *Helix fruticum*, Müller: G. K. Gude.

SATURDAY, JUNE 13.

ROYAL INSTITUTION, at 3.—Studies on Expression in Art. II.: Right Expression in Modern Conditions: Sigismund Goetze.

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THURSDAY, JUNE 11, 1914.

THE PURPOSE OF YOUTH.

The Childhood of Animals. By Dr. P. Chalmers Mitchell. Pp. xiv + 269 + plates. (London: W. Heinemann, 1912.) Price 10s. net.

THIS remarkably fine book is a work of distinction—both of style and insight. When an author has a story of his own to tell and knows how to write, the outcome is often a book of delightful descriptive natural history, but Dr. Chalmers Mitchell has much more to give us than that. He has succeeded in making us read biology without knowing it. With a charming subject to start with, with a wide experience to draw from, with an infectious sympathy for youth, and with a well-thought-out biological system, he has given us a really big book—and happy are those who have found it. A great pleasure it is to discover a work with so many interesting facts and so wholesome a salting with ideas, written in a style that is individual and charming. We congratulate the author on achieving a conspicuous success. Most naturalists like their natural history "dry," and few of them have much use for popular expositions, but "The Childhood of Animals" is a book by itself, which takes a grip. The author has been extraordinarily fortunate in his artists; the Japanesque colour-studies are revelations of character and the black and white drawings are also very pleasing and effective.

Without insisting on it too much, the author divides animals into three sets—those which have no youth, such as amœbæ (but is it not rather that they never grow up?); those which are quite different from their parents when they are young and on a different line of life, such as caterpillars, tadpoles, and other larvæ; and those which are born in the likeness of their parents, but have a very distinct youthful period, such as most higher vertebrates. He contrasts the various kinds of life-history; and shows that in relation to particular conditions one chapter is often lengthened out and another shortened down. Adult life may be condensed into a few days or even hours; it may even be lost altogether, as in pædogenesis. Larval life may be so hazardous, on the other hand, that it is all, as it were, telescoped into the egg. Part of the tune may be played very slowly, part very quickly, and another part left out altogether; and all this is, on the whole, adaptive, the result of selecting out temporal variations in reference to the conditions of life. In some cases, perhaps, it works the other way round, that a type born, as it were, old, seeks out conditions of life suitable for this kind of constitution—parasitism for choice. But our author does not go into this.

From the treasury of interesting things that the book contains it is difficult to select, but we may refer to three. The first is the masterly treatment of the coloration of young animals. Starting with the sound idea that the pigments are primarily by-products of the metabolism, and the patterns expressive of growth-rhythms, Dr. Chalmers Mitchell shows how in one case they are tolerated, and in another toned down, and in another specialised. Young animals tend to show the more primitive types of coloration—a spottiness, for instance, which corresponds to the particulate character of the skin, and while this is often very useful, it requires no special utilitarian interpretation. Later on, the spots may combine into bands and stripes, or the pattern may be blurred and toned down, or it may be overlaid by a new pattern, often of ruptive vividness, which breaks up the natural outlines and makes the animal inconspicuous, or forms startling and attractive sex-decorations. It is in interpreting the post-juvenile coloration that we must call in the aid of the selection theory.

Another subject well dealt with is the progressive reduction of the number of offspring. In the lower reaches of the animal kingdom there is prolific multiplication and high mortality. But it has been one of the great steps in evolution to economise life by parental care, of which affection is a consequence. "The mere toleration of the young by the mother is a new beginning in life, and is the foundation of many of the highest qualities displayed by the highest animals and by man himself. . ." The relations of the young to the mother "are a continuation of the organic relation by which the young are born of the body of their mother, and they exist and become, so to speak, a habit before the individuality, the physical powers, and the senses and aptitudes of the young are really awakened."

Perhaps, however, the most prominent thesis of the book concerns the purpose of youth. This is in a word self-expression. Why as we ascend the scale of being is there this lengthening of the period of youth? Why are the young creatures fed, protected, freed from care, dowered with energy, and given full scope for play? The purpose of youth is to give time for the breaking down of rigid instincts, and their replacement by actions controlled by experience and memory—by remembered results of experiment. Youth is perilous, but the risks run have been justified—are continually being justified—in the complexifying co-ordinations established by the brain-cells. This means the growth of intelligence and the deepening of feeling. And if natural history is asked to give hints to the human educationist, one of them is this: "Youth should be spent in blunting (a term apt to be misunderstood?) every instinct, in awakening and stimulating every curiosity, in the gayest roving, in the wildest experiment. The supreme duty of youth is to try all things."

MANUALS OF BOTANY.

(1) *Pflanzenmikrochemie. Ein Hilfsbuch beim mikrochemischen Studium pflanzlicher Objekte.* By Dr. O. Tunmann. Pp. xx+631. (Berlin: Gebrüder Borntraeger, 1913). Price 18.50 marks.

(2) *Researches on Irritability of Plants.* By Prof. J. C. Bose. Pp. xxiv+376. (London: Longmans, Green and Co., 1913.) Price 7s. 6d. net.

(3) *Plants and their Uses. An Introduction to Botany.* By F. L. Sargent. Pp. x+620. (New York: Henry Holt and Co., 1913.)

(1) BOTANISTS who have not kept in touch with the more recent advances in the microchemistry of plants will be surprised at the size of this work with its 600 closely-printed pages. The book is divided into a general and a special part. In the first part we have, first, sixty pages dealing with methods of preparing and preserving material and with various other special methods such as filtering, centrifuging, sedimentation, micro-sublimation (a method of great value in many cases), clearing, swelling, bleaching, maceration, etc. In the second part the methods of recognising the various elements of the ordinary inorganic substances of the plant are considered, and later the various classes of organic substances are dealt with fully. The author, however, does not stop here, but in the last 200 pages passes in review the microscopical characters and the chemical nature of protoplasm, cell-wall, and cell-inclusions generally; this section includes details of fixing and of the staining reactions of the various cell elements. It will be seen that the author interprets his subject very broadly as, in fact, coextensive with botanical microtechnique.

The need for such a book is very obvious since the last work covering such a field was very much smaller and was published in 1892. Dr. Tunmann has made many contributions himself to the study of plant microchemistry, and no one could be better fitted to prepare such a work.

The literature of the subject has been worked up in a way which must have taken years to complete and nearly every page bristles with references; the work is, however, no mere compilation, for the physiological aspects of the different substances are briefly dealt with and many methods critically discussed. Of course, it is impossible to read and criticise this book as a whole, but when tested in relation to a number of diverse substances, such as the microscopical recognition of potassium, of formaldehyde, of sugars, etc., it has proved to be thoroughly up-to-date. Botanists, plant biochemists, and those who have to deal with the recognition of vegetable tissues and drugs used in pharmacy are under a heavy debt of gratitude to the author. The book should be on the shelves of every botanical, biochemical, and pharmaceutical library.

(2) This volume is the fourth of the series of books in which Prof. Bose has applied the delicate methods of the physical laboratory to the study of the irritable responses of plants and animals. As his previous work has shown, the author looks upon the plant as a very peculiar machine of which the sole source of energy is that which plays upon it directly from without! Such views, however, should not blind plant physiologists, and animal physiologists interested in the neuro-muscular electrical response, to the solid value of many of the results obtained and to the usefulness of the ingenious and delicate apparatus devised by the author. His resonant recorder is a beautiful piece of apparatus in which the recording lever is made to vibrate to and fro and so to make only an *intermittent* contact with the recording surface; the friction between the lever and blackened surface is thus enormously reduced. By means of this apparatus and of another ingenious instrument, the oscillating recorder, the delicate movements of the leaves of Mimosa and Biophytum have been recorded for the first time without distortion, and so the latent period and the rate of transmission of a stimulus carefully measured. Very good reasons are given for the belief that in Mimosa an impulse cannot pass through dead tissues, in the manner commonly accepted, as a mere hydro-mechanical disturbance, but only through living protoplasm, the mode of transmission being essentially similar to that of a nervous impulse.

There is much other work of importance, especially in connection with electrical responses, and one is glad to note that startlingly unorthodox views are much rarer than in previous works. Prof. Bose, however, must be unaware of, or careless of, the prejudices of biologists or he would not put forward, without the support of further experiments, the conclusion that in a bean leaf "on account of fatigue, the death point was lowered from the normal 60° C. to 37° C."

(3) This book is described as an introduction to botany. The plan of the work is based on the

view that the beginner in botany should first learn about economic plants and classify them scientifically and later deal with other aspects of the subject. In accordance with this view it begins with a preliminary chapter on the way in which botany arose, how plants are named, and the nature of varieties, species, and genera. In the next chapter, thirty-four pages are devoted to the cereals; the characteristics, floral and otherwise, of the various forms are described, maps of their probable origin and present distribution are given, and their suitability to various habitats pointed out. At the end of this chapter, the nutritive value of the grain of various cereals is considered, and the nature of carbohydrates, proteids, and fats briefly indicated. In the third chapter, other food plants are considered, such as nuts, pulse, earth-vegetables, herbage-vegetables, fruit-vegetables, and miscellaneous food-products. After this review of the chief food-plants a discussion of food as a fuel and building material is provided, and the energy available in fats, carbohydrates, and proteids is considered, leading finally to the question of the composition of a suitable ration. Then we have chapters on flavouring and beverage plants, on medicinal and poisonous plants, and on industrial plants, *i.e.* plants yielding fibres, wood, gums, fuel, etc. Then follow chapters on classification, and on the parts of a flowering plant, and a chapter on evolution, adaptation, and natural selection. At the end of the book the chief groups of algæ, fungi, liverworts, mosses, and pteridophyta are all surveyed in no more than eighty pages. Finally we have a chapter on the plant's place in nature, which includes a semi-philosophical discussion of the distinction between the living and the non-living.

This brief statement of the contents of the book will show that the author has great faith in the powers of mental digestion of beginners, and does not hesitate to provide them with plenty of "fine, confused feeding." The earlier chapters of the books might perhaps be usefully read by an advanced student interested in the economic side of the subject and in classification, but they are almost too full of information to be used other than for reference. As an introduction to botany, however, the book is an anachronism. It might have been so used when classification practically embraced the whole subject, but nowadays it is generally agreed that the student should gain as early as possible a clear conception of the plant as a working whole. But in this book the student may peruse 500 pages without gaining any clear idea of the function of the parts of the plant. There is no description of the internal structure of a stem, root, or leaf of a flowering plant, or any mention of a chloroplast, or any description of a cell of a higher plant. Useful as the earlier chapters may be to other readers, the book appears to be quite unsuitable for a beginner, who should not be plagued too severely with information, but by proper selection of material should be led to acquire sound general views of his subject. The author states that he has "tried to write such a book as I believe would have been most useful to me as a beginner." If the author has really succeeded in recapturing his impressions as a tyro in the subject, his needs must have been very different from that of any elementary student that the reviewer has ever met.

V. H. B.

GERMAN POPULAR SCIENCE.

(1) *Bücher der Naturwissenschaft.* Edited by Prof. Siegmund Günther. 21 vols. (Leipzig: Philipp Reclam, jun., n.d.) Price 1 mark each.

(2) *Aus Natur und Geisteswelt: Sammlung wissenschaftlich-gemeinverständlicher Darstellungen.* 442 vols. (Leipzig: B. G. Teubner, n.d.) Price 1.25 marks each.

(3) *Naturwissenschaftliche Bibliothek für Jugend und Volk.* Edited by Konrad Höller and Georg Ulmer. 23 vols. (Leipzig: Quelle und Meyer, n.d.) Price 1.80 marks each.

(4) *Series of Science Books for Austrian Secondary Schools.* Published by F. Tempsky, Vienna, and G. Freytag, G.m.b.H., Leipzig. Price 2 to 5 kronen each.

(1) THE idea underlying Dr. Günther's series is to select a limited area of some scientific subject, and to treat it in a modern and popular manner which combines attractiveness with accuracy. Some of the latest volumes of this series are Lampert's "Vom Keim zum Leben," a very readable account of plant and animal development; Prof. Wieleitner's "Schnee und Eis der Erde," nicely illustrated with photographs of "penitents" and other remarkable ice formations; Dr. Hempelmann's "Der Wirbeltier-Körper," a useful though rapid summary of comparative vertebrate anatomy; Prof. Pahde's "Meereskunde," in which the latest results, such as those of the hydrodynamical theory of ocean currents, are clearly brought to bear; Dr. Speter's "Chemische Verwandtschaft," and Heinrich Leiser's "Welt der Kolloide," the latter a fascinating presentation of the rapidly growing science of colloids; and an excellent little manual on heat by the late Robert Geigel.

(2) Teubner's "Natur und Geisteswelt" series is an exceptionally large undertaking of the same kind. Among typical recent volumes may be cited a very valuable booklet by Max Verworn

entitled "Die Mechanik des Geisteslebens," in which the modern theory of neurons is brought to bear upon a wide range of nervous and psychical processes, from memory and will to fatigue, suggestion, and hypnosis. Among other works of this series we may mention a charming volume on the origin of the universe and the earth according to legend and science, by M. B. Weinstein; several anatomical volumes by K. von Bardeleben; a useful volume on the microscope by Prof. W. Scheffer; a book on radium by Dr. Centnerszwer; some volumes on steam and heat engines by Prof. Vater; and a very readable and up-to-date volume on aeronautics, "Die Luftfahrt," by Dr. R. Nimführ.

(3) The "Naturwissenschaftliche Bibliothek" is frankly intended for juvenile readers. The books are very attractively produced, and some of them leave nothing to be desired as regards simplicity and clearness. This is notably the case in Hahn's "Chemisches Experimentierbuch" and Heller's "Das Aquarium." Otto Krieger's "Wie ernährt sich die Pflanze?" is well written, but more adapted to adults, and this may be said more emphatically of Gothan's "Vorgeschichte der Pflanzen" and Reukauf's "Mikroskopische Kleinwelt unsrer Gewässer." The special volumes on aquatic insects (Ulmer), bees and wasps (Scholz), and singing birds (Voigt) are very readable books, without any striking or original features.

(4) Messrs. Tempsky's manuals are intended for the various stages of the gymnasien, mädchengymnasien, realschulen and realgymnasien of the complex German and Austrian system of secondary education. In some of them, such as Graber's "Leitfaden der Körperlehre und Tierkunde," coloured plates are judiciously supplemented by colouring specially important illustrations in the text, an innovation which deserves to be more widely adopted. The volumes form a highly creditable set of schoolbooks, covering geology, mineralogy, botany, zoology, chemistry, and hygiene. Unlike the other three series, they are printed in Roman type.

OUR BOOKSHELF.

Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts, No. 273. Beiträge zur Geschichte der Meteorologie. Von G. Hellmann. Nr. 1–5. Pp. 148. (Berlin: Behrend and Co., 1914.) Price 5 marks.

FOR many years past meteorological bibliography has been greatly enriched by the laborious and painstaking researches of Prof. G. Hellmann on the origin of observations and instruments. The volume now before us forms No. 273 of the "Publications of the Royal Prussian Meteorological Institute," and contains five contributions, the first of which occupies ninety-eight quarto pages, with many facsimile extracts and plates, and refers to the reign of astro-meteorology. A masterly account is given of the extraordinary literary controversy caused all over Europe by J. Stöffler's prediction of a deluge in February, 1524, due to an unusual number of conjunctions of the planets in the Constellation Pisces. This prediction was contained in the *Almanach nova*, published at Ulm in 1499, with ephemerides in great detail down to 1531 (thirty-two years in advance). Needless to say, the prophecy was not fulfilled; some of the astrologers maintained, however, that it was correct in theory, and the Arab doctrines required amendment to take into account the promise made to Noah. The two following articles refer to the oldest meteorological observations in Germany (Hanover, 1678), and the oldest printed description of aurora borealis (1527), both of which dates are a few years earlier than previously stated. These are followed by a first attempt at arranging the combined literature of meteorology and theology, in so far as the titles give a clue to the contents, *e.g.* special sermons, etc. The last contribution is a very interesting account of the predecessors of the Mannheim Meteorological Society (1780–95), the first really successful establishment of an international meteorological system of observations. The first attempt was due to Ferdinand II, Grand Duke of Tuscany, about 1654.

Photography in Colours. A Text-book for Amateurs and Students of Physics: with a Chapter on Kinematography in the Colours of Nature. By Dr. G. L. Johnson. Second edition. Pp. xv + 243. (London: George Routledge and Sons, Ltd., 1914.) Price 3*s.* 6*d.* net.

A REVIEW of the first edition of Dr. Johnson's book will be found in the issue of NATURE for February 23, 1911 (vol. lxxxv., p. 539). The volume has been subjected to a thorough revision. Most of the best-known colour processes are described; an extra chapter has been added dealing with the "Utocolor" process of printing in colour direct from colour photographs; and an outline of modern views as to the nature of light and colour is now included.

Poems of Human Progress and Other Pieces: including One Hundred and Fifteen Sonnets. By J. H. West. Pp. xii + 328. (Boston: The Tufts College Press Publishers, 1914.) Price 1.50 dollars.

THE first of Mr. West's poems, "Man's Triumph-Era," was the Phi Beta Kappa poem read at Tufts College, in 1906, at a meeting of the Delta Chapter of Massachusetts, and depicts a walk with college men, with discourse on human progress. The second extended effort, "The Epic of Man," was read in 1908 in Boston, at the annual convention of the Free Religious Association of America. The poems and sonnets may be commended as affording a favourable example of contemporary American verse.

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.*]

Weather Forecasts in England.

MR. MALLOCK'S position in the scientific world is one of distinction and his letters on the subject of weather forecasts in England, which appeared in NATURE of February 26 and June 4, can, accordingly, scarcely fail to be regarded by many who are unfamiliar with the circumstances as reflecting injuriously upon the department of the public service which is in my charge. I ought, therefore, not to let them pass unnoticed.

Let me say that the method of checking forecasts employed by Mr. Mallock as described in the letter of February 26 would be scouted in the Meteorological Office, whatever the result might be, partly because the classification of the weather adopted therein is quite inadequate, and partly because the conditions at a single hour of the day (7 a.m. only) are used as an indication of the weather comprised within the period of twenty-four hours extending from noon to noon. In the Meteorological Office, for checking forecasts, the practice was to use three maps for each day in conjunction with the schedules of observations collected for the daily and weekly reports. For the last year or two these observations have all been charted, so we now use ten maps for each day. Specimens were exhibited at the last soirée of the Royal Society. The stricter examination is sufficiently encouraging to the forecaster.

No one can wonder that Mr. Mallock revives and cherishes an objection to the accumulation of observations, because the picture which he draws of the state of the atmosphere, and upon which, in his second letter, he founds his gloomy forecast of the future of forecasting, will not stand comparison with the facts of observation. There is no belt of north-east or south-east winds *all round the globe*, as represented in Mr. Mallock's diagram; that notion is a survival of times long gone by, and is inconsistent with Buys Ballot's law, as well as the facts set out, for example, in Hildebrandsson and Teisserenc de Bort's "Les Bases de la Météorologie Dynamique: Historique—état de nos connaissances," or, more simply, in "The Barometer Manual for the Use of Seamen."

The notion of a collection of eddies in a quiescent atmosphere covering the temperate and polar regions was also quite familiar to the meteorologists of thirty years ago when the vortex theory was as fashionable as the *quantum* theory is now. It derives much support from the study of the water of a flowing stream, or near a moving ship; only, unfortunately, in the atmosphere there are no huge moving ships to cause eddies of any diameter up to a thousand miles or more; and if there is a flowing stream Mr. Mallock does not describe it. There is no machinery round the tropic of Cancer, like the popular lecturer's smoke-box, for launching a succession of vortices on a brief career of degradation. The theory that cyclonic depressions are vortices has never led to any real advance in our comprehension of the atmosphere, outside the region of tropical revolving storms; whereas the close study of observations such as those of the Daily Weather Report has led, and is leading, slowly but surely towards understanding the physics of the phenomena.

I should like to suggest to Mr. Mallock and other distinguished men of science who are kind enough to take an interest in meteorology, that to stick a pike through the front rank of the fighting line in the manner recently represented by "Mr. Punch," is not very helpful to the promotion of natural knowledge. If they in their turn feel bored by observations, let them help us to attack some of the citadels for the reduction of which we have very few observations to help us. I cannot offer them the surface or the troposphere for the purpose; the observations are too numerous. But the all-embracing stratosphere is open to their imagination with very few observational restrictions. Let me set out my own imperfect idea of the problem with the object, not of prolonging this correspondence, but of eliciting a valuable contribution to knowledge, in the shape of a paper, or even a book.

Imagine a shell of upper atmosphere containing no water-vapour, separated from the moist lower atmosphere by a smooth surface which, for the time being, we will suppose a "level surface." The shell under consideration is isothermal or increases in temperature upwards, until a region of approximately uniform temperature is reached. It is imperfectly transparent to radiation, but it has no convection of the ordinary local character, and is supposed not to be affected by convection from below. In this environment, considerations of stability may lead us to conclude that locally cooled air will find its way over the smooth surface towards the equator and locally warmed air towards the polar regions. So, we shall get primarily a concentration of cold air over the equator and warm air over the poles. That, apparently, does really occur. The wandering of the air poleward will eventuate in an eastward circulation, the wandering towards the equator in a westward circulation. Outside the equatorial region horizontal pressure-differences will be balanced by the easterly motion, the lines of flow, in the temperate and polar stratosphere, being at once isobaric lines and isothermal lines; so far as we are able to tell, low pressure is warm and high pressure cold.

What will happen in consequence of the alternate solarisation and sky-radiation of this stratosphere by day and night I must leave the theoretical theorist to say; observation has not yet told us. I will, however, venture to suggest that the air cap of the winter pole must get colder and colder; ultimately so cold that it will wobble and get displaced by warmer air; and, yielding to the centrifugal influence, it will slide towards the reservoir of cold air over the equatorial regions. On its journey it may give rise to easterly or northerly currents in the temperate stratosphere which are occasionally observed, and which are, at present, unexplained.

Some of the suppositions in the statement which is here presented are based on observations with which I am familiar, though the guidance that can be got from observations in this matter is woefully incomplete; but one, at least, is frankly hypothetical, and my question is, whether, from the mathematical point of view, the picture may be regarded as true to life and, if not, how it should be emended. The problem is quite simple compared with that presented by the observations of the Daily Weather Report. There is no water-vapour, no convection in the ordinary sense, and no surface friction. If some philosopher, who thinks observations unnecessary, will give us a working solution, he will be a real benefactor to meteorology; because we know that the stratosphere exerts a dominant influence upon the distribution of pressure at the surface, which controls our weather, and we have no working outline of what happens up there. Theory might help us; perhaps Mr. Mallock will oblige.

His letters do not, I think, entitle him at present to be placed in the category of benefactors, because his checking is unsound and his theory is out of date. Even if he had succeeded in what appears to be his immediate object, and had cooked the forecaster's goose, it would have made a sorry meal. Those who are acquainted with the history of meteorology in this or any other country know that whatever may be the merits of the bird herself, as long as she lives she may lay golden eggs which are very sustaining for the progress of science.

Official forecasts for twenty-four hours in advance are often right and sometimes wrong, but the study of the daily weather by means of maps has a fascination which increases year by year as the observations become more precise and the area covered becomes wider and wider. "Age cannot wither nor custom stale its infinite variety." The subject is so complex and so varied that it is mere vanity to think of taking up the whole of it at once and producing a complete solution applicable to the whole of time. We must take the pieces which our intelligence, such as it is, enables us to tackle. Quite apart from the practical utility to the public, of which others must judge, and which is not quite a single-valued function of accuracy, the daily forecast is absolutely indispensable for the student of atmospheric physics. The daily map serves also a variety of useful public purposes of which the forecasts are only one.

Notwithstanding Mr. Mallock's theory, the forecasts for twenty-four hours are gradually getting more accurate; but, even if his contention were valid, I should still ask to be allowed to continue the study of the daily observations, as my predecessors did from 1867 to 1879, when the issue of forecasts was, once before, suspended in deference to the representations of the learned.

W. N. SHAW.

June 5.

Cellular Structure of Emulsions.

THE letters and photographs published on this subject do not make it quite clear whether the cellular structure observed is confined to the surface, or exists in the interior of the emulsion. Superficial cellular structure is by no means uncommon, and is shown to advantage by thin layers of heavy tar-oil or benzaldehyde on the surface of water. If the phenomenon under discussion is restricted to the surface, it probably falls, as suggested by Mr. Harold Wager, under the heading of the "cohesion figures" first studied by Tomlinson. If, however, the cellular structure extends throughout, some further explanation is necessary, and it would be interesting to know whether any such cases have been observed.

CHAS. R. DARLING.

City and Guilds Technical College, Finsbury, E.C.

β and γ Rays and the Structure of the Atom (Internal-Charge Numbers.)

IN a previous letter to NATURE (December 25, 1913, p. 477) it was suggested that "a cluster of α particles *only* may be at the centre of the atom," and that, though the innermost electrons "may have no influence at all on the properties of the elements, and for an electron (or α particle) penetrating from without will belong to the nucleus (see NATURE, November 27, 1913, p. 372), a β particle ejected from near that cluster must pass all other electrons and excite radiation different for each, as dependent on the (successively changing) charge within."

The word "ring" has here been purposely omitted; for from the wave-lengths of the soft γ rays (L radiation) of radium B (Rutherford and E. N. da C. Andrade, *Phil. Mag.*, vol. xxvii., 1914, p. 861), and of the β-ray spectrum of this substance (Rutherford and Robinson, *Phil. Mag.*, vol. xxvi., 1913, p. 724), it may be seen that these frequencies are nearly equal to the square of (probably all) integers from P, the periodic number to A/2, half the atomic weight, multiplied by a constant ($3\cdot942 \times 10^{11}$/sec.), and that the β-ray spectrum contains only velocities equal to (probably all) integers from P to A/2, multiplied by a constant ($3\cdot175 \times 10^{8}$ cm./sec.), so that all the radii of the inner electrons should be different, and these electrons must "be moving in a manner prohibiting any two of them from forming a ring," but not "either form a single ring or rings in parallel planes" (J. W. Nicholson, NATURE, May 14, p. 268, and *Phil. Mag.*, April, 1914, p. 557, respectively), forming a "planetary" rather than a "Saturnian" atom. (P = the periodic number = the number of peripheric electrons; see NATURE, December 25, 1913, p. 477, and March 5, 1914, p. 7, and the periodic system in Table II.)

TABLE I.

I.	II.	III.	IV.	V.	VI.
Charge	$\lambda . 10^{8}$	$\sqrt{\nu} . 10^{-9}$	N_γ	β	N_β
107—99	—	—	—		
98	0·793	1·945	98·0		
97	0·809	1·926	97·0		
96	—	—	—		
95	0·838	1·892	95·3		
94	0·853	1·877	94·5		
93	—	—	—		
92	—	—	—		
91	0·917	1·809	91·1		
90	—	—	—		
89	0·953	1·773	89·3		
88	0·982	1·748	88·0		
87	1·006	1·727	87·0		
86	1·029	1·708	86·0		
85	1·055	1·687	85·0		
84	1·074	1·670	84·1		
83	1·100	1·650	83·1		
82	1·141	1·620	81·6		
81	1·175	1·597	80·4		
80	1·196	1·583	79·8		
79	1·219	1·569	79·0		
78	1·266	1·539	77·5	0·823	77·8
77	1·286	1·528	77·0	—	—
76	1·315	1·510	76·0	0·805	76·0
75	1·349	1·49[illegible]	75·0	0·797	75·3
74	1·365	1·482	74·6	0·787	74·4
73				—	—
72				0·762	72·0
71				0·751	71·0
70				—	—
69				0·731	69·1
68				0·719	68·0
67				—	—
66	Faint lines.			0·700	66·1
65				—	—
64				—	—
63				—	—
62				0·656	62·0
61				—	—
60				0·635	60·0

I. The possible charges for each electron.
II. The wave-lengths of the γ rays of RaB.
III. The square root of these γ-ray frequencies.
IV. The possible charges calculated from III.
V. The velocities of the so-called β rays of RaB.
VI. The possible charges calculated from V

From the K radiation lines (Moseley, *Phil. Mag.*, April, 1914, p. 706), the very penetrating γ rays of radium B may be expected to have frequencies equal to the square of (probably all) integers from $P=60$ to $A/2=107$, multiplied by $2{\cdot}48\times10^{15}$/sec. Hence for uranium frequencies up to $2{\cdot}85\times10^{19}$/sec. might exist. Of course, on this view different elements must have partly equal β and γ rays, and the so-called β-ray spectra be those of electrons expelled by the β particle, and not of the β particles themselves.

As "there is also a large group of faint lines between 14° and 22° which do not permit of accurate measurements" (*loc. cit.*, p. 859), it may be observed that 22° corresponds to a charge of 64, so that all lines fall within the limits given above.

TABLE II.—*The "Condensed" Periodic System with (1–70) the Periodic Numbers.*

							0H—He
1Li	2Be	3B	4C	5N	6O	7F	8Ne
9Na	10Mg	11Al	12Si	13P	14S	15Cl	16Ar
17K	18Ca	19Sc	20Ti	21V	22Cr	23Mn	24Fe—Co—Ni
25Cu	26Zn	27Ga	28Ge	29As	30Se	31 Br	32Kr
33Rb	34Sr	35Y	36Zr	37Nb	38Mo	39—	40Ru—Rh—Pd
41Ag	42Cd	43In	44Sn	45Sb	46Te	47I	48Xe
49Cs	50Ba	51La, etc.	52, etc.	53Ta	54W	55—	56Os—Ir—Pt
57Au	58Hg	59Tl	60Pb	61Bi	62—	63—	64Nt
65—	66Ra	67Ac	68Th	69—	70Ur	71—	72— — —

It would seem that there is no reason, why such a structure, though not observable by lack of γ radiation, should not belong to all elements. But it is perhaps not compatible with Bohr's atomic model. With Moseley's formula for the L radiation $A(N-7{\cdot}4)$ it is not; but if here $(N-7{\cdot}4)$ be multiplied by 1·008, all values for $(N-7)$ are integers $(\pm0{\cdot}2)$ also, and the same holds for all Moseley's series, so that, if $N=M$, $\nu=A(M\pm n)$, and n is any number of electrons between certain limits.

A. VAN DEN BROEK.

Gorsel (Holland), May 19.

FORESTRY AND FOREST RESERVES IN NEW ZEALAND.[1]

THE recently-published report of the New Zealand Commission on Forestry contains much that is of general interest, apart from the aspects of the forestry problem affecting that Dominion in particular. New Zealand has magnificent forests, especially of conifers and southern beeches, with a present area of about twelve million acres. The forest area has been reduced by nearly one-half since about 1830, and during the last ten years the annual cut has doubled, so that despite the steps that have been taken since about 1875 to prevent waste and to afforest suitable areas, the forest capital is dwindling at an alarming rate.

Since the New Zealand forest flora includes a number of species which are of unusual interest as representing the most primitive types of gymnosperms, particularly among the families Araucarineæ and Podocarpineæ, it is gratifying from the botanical as well as from the economic point of view that vigorous steps are now being taken by the Dominion Government to conserve the native trees, as well as to inaugurate a far-reaching scheme of afforestation. Of the endemic trees, the "Kauri pine" (*Agathis australis*) is among the most valuable timbers of the world, and though it is still fairly abundant, its distribution is limited to the northern portion of the North Island, it is very inflammable, and it takes from six hundred to about three thousand years to attain its full size. Besides yielding the valuable copal-like resin which is largely exported to the United States and to this country, the Kauri produces timber which is unrivalled for shipbuilding and for other purposes to which it is adapted, owing, above all, to its freedom from knots—a condition secured through the function of an absciss-layer causing self-amputation of branches. The other New Zealand conifers, including timber trees of great value, also suffer, though in a smaller degree, from this drawback of slowness of growth, and it is therefore necessary to plant introduced trees which are found to grow four to ten times as rapidly as the native species.

As we learn from this report, the forestry problem is being faced in a systematic manner by the New Zealand Government, and forestry promises to develop into one of the most important and permanent industries of the Dominion, which, though precluded by its geographical position from becoming to any appreciable extent a contributor to the world's supply of timber, can, at any rate, meet its own wants, and probably continue in an increasing degree to assist Australia, where the shortage of structural (coniferous) timber is now leading to a steady annual rise in the amount imported from Europe and North America, as well as from New Zealand. About 60,000 acres have already been afforested, but this will be greatly increased in the near future, since it is estimated that at the present rate of consumption the indigenous forests will be exhausted in about thirty years.

While much of the report is, naturally, concerned with the special needs of New Zealand—a large section being devoted, for instance, to the question of suitable wood for butter-boxes, in view of the important and increasing dairy industry—there are various matters of general interest, among which we may note particularly the formation of climatic and scenic reserves.

A climatic reserve may be defined as a nature reserve selected for the purposes of protection of soil, prevention of denudation, water conservation, prevention of floods, and shelter from winds. In relation to its area, few countries in the world are in greater need of an adequate forest covering

[1] Report of the Royal Commission on Forestry. (Wellington, New Zealand: John Mackay, Government Printer, 1913.)
Report on Scenery Preservation. New Zealand Department of Lands. (Wellington, 1912.)

on their high lands than is New Zealand. The lofty mountain ranges which traverse both islands, and the excessively broken nature of the land over large areas, together with an average high rainfall, lead to the presence of innumerable streams, and offer ideal conditions for denudation; hence the mountains would, if not forest clad, be a constant source of danger to the farm lands on which the prosperity of the country so largely depends. The original covering of forest, which —except where soil or climatic conditions were adverse—occupied the whole land, and extended to a height of between 3000 and 4500 ft., has now been enormously reduced, and there has been much unnecessary destruction extending to the steep slopes of hills, and even to the upper altitudinal limits of the forest; hence the head-waters of many streams are no longer provided with tree cover, and the general watersheds of the larger rivers have lost their original efficient protection. The commission strongly recommend, therefore, that these mountain forests should be strictly preserved against further interference, and that every factor which is destructive to the forest undergrowth should be rigorously repressed—this will entail the restriction of deer and other destructive animals to limited enclosures.

The importance of scenic reserves, which includes several distinct classes of reserve, is fully realised by the enlightened Government of the Dominion, which is annually adding large areas to its already long list of such reserves, and is in this respect setting a splendid example to older countries. In this connection it may be noted that of the seventeen hundred species of trees, shrubs, herbs, ferns, and fern allies included in the New Zealand flora, more than three-fourths are found nowhere else in the world, and that this vegetation is, except where disturbed by human occupation, of a truly primitive type. In 1903 Sir Joseph Ward, then Minister in charge of the Tourist Department, introduced the Scenery Preservation Act, which provided for a Royal Commission to report upon all areas possessing scenic or historic interest, or on which there were thermal springs, and submit recommendations for the acquisition of such as seemed desirable, whether Crown, freehold, or native. After this commission had worked for two years, it was terminated by an amending Act substituting a small permanent advisory board of Government officials, the Scenery Preservation Board, which investigates and reports from time to time on all areas worthy of inspection, and by a further Act passed in 1910 the whole of the reserves were made sanctuaries for the flora and fauna, so that no firearm may be discharged on a scenic reserve, nor may any bird or game be killed thereon. The reserves now set aside for scenic purposes number 518, and there are also five national parks consisting for the greater part of extremely steep land, much of which is at a high altitude and more or less barren, while three islands have been set apart for the protection of New Zealand birds. The Forestry Commission recommend the constitution of a further series of scenic reserves.

The report for 1912 of the Scenery Preservation Board shows that during the year ended March 31, 1912, there were acquired no fewer than ninety-six additional reserves, with an aggregate area of 94,000 acres, at a total cost to the Government of less than 6000*l.*, the latter figure including as the two heaviest items the expenditure involved in survey and the compensation paid for private and native lands acquired. F. C.

THE PRINCIPLE OF RELATIVITY.
I.

PERHAPS the most comprehensive generalisation in physical science since Newton's enunciation of the law of gravitation is the conception of an all-pervading æther, the medium of transmission of light and of electrical and magnetic disturbances. From the time when Maxwell adopted this conception from Faraday and established the identity of light and electric waves, the "æther" has become a fundamental element of our thought about the physical world.

But it has been a standing puzzle for many years to find out whether the æther is pushed and carried along by the earth as it moves or whether it is of such a nature that it can pass through solid matter so that we may think of it as undisturbed by the motion of bodies through it. Without going over the history of the controversy it may be stated that by the beginning of this century it had been almost universally accepted that the simplest way to think of the æther was to suppose it to be stagnant and immovable. Thus there seemed a possible solution to an older puzzle, that of the failure of mechanics to specify a unique and universal frame of reference for the motion of bodies. The æther promised to supply one. But, unfortunately, when experiments were devised to determine the velocity of the earth relative to the æther, they one and all failed. Thus came into being the principle of relativity, which is simply the *hypothesis* that *we never shall know or be able to define what is the exact velocity of the earth or any other body relative to the aether.*

Of course, this must not be taken as a dogmatic assertion or a philosophic doctrine, but as a working hypothesis, the consequences of which are to be examined and verified at every possible point by comparison with experiment. But the boldness of the hypothesis requires a little justification. It arose, as a matter of fact, directly out of the theory built up by Lorentz and Larmor on the basis of a stagnant æther for the purpose of explaining the failure of the experiments that have been referred to. This theory was so comprehensive that it distinctly predicted the failure of all conceivable experiments designed for the purpose of identifying the æther as a frame relative to which the velocities of bodies might be measured; just as the comprehensive dynamical theory of Newton, though at the outset it postulates a standard of absolute position, involves the consequence that this standard cannot be a unique one. When, for example, Lord Rayleigh conceived and carried out in 1902 an experiment in which he sought to find evidence of double refraction in a plate of glass owing to its motion through the æther, Sir Joseph Larmor gave it as his opinion that the negative result was to be expected on theoretical grounds.

It may be taken indeed as proved that in so far as matter is electrically constituted, the form of the equations which embody the theory is such that effects due to the motion of bodies as a whole through the æther must always be concealed.

But is matter of purely electromagnetic constitution? Are existing theories able to give a complete account of those phenomena which have actually been experimentally investigated?

The classical experiment of Michelson and Morley may be taken as an example on which to test these questions. It is generally admitted that this experiment shows that we cannot detect a difference in the velocity of light relative to the earth in two directions at right angles one of which may be thought of as parallel and the other perpendicular to the motion of the earth through the æther. Such a difference must exist if light is thought of as being propagated with the same velocity in all directions relative to the æther.

The only suggestion that could be made to reconcile the failure of the search for this difference with the theory of a stationary æther was that of FitzGerald, that the motion of the apparatus through the æther so modifies its internal constitution that it automatically contracts to an extent which exactly neutralises the effect which would otherwise be observed. It was in the effort to give a reason for this contraction that the theory that has been referred to was developed. But whether we take the presentation given by Larmor or Lorentz we find that the general equations of the electromagnetic field have to be supplemented at some point by a hypothesis as to the nature of the electrons which are the elementary constituents of matter, in order to make the scheme sufficient to determine the way in which they will move. Now the length of a body, thought of as constituted by electrons, depends upon the motions of those electrons. If we are to think of any piece of matter whatever as contracting according to FitzGerald's hypothesis, we are bound to think of the paths of the electrons within the body as being modified in some corresponding way. Thus the hypotheses that may be adopted as to the nature of the electron are not arbitrary, but must be such as will lead to the contraction hypothesis as a consequence.

Similarly, if we consider the experiment of Rayleigh referred to above, the refracting properties of glass are conceived to be due to the light waves falling upon electrons which have inertia and which have to be moved by the electrical forces produced by the light. If we were to assume that the electrons have a definite mass in the Newtonian sense, then Rayleigh's expectation of a double refraction when the glass is moving would be justified. Lorentz is able, however, by assuming *among other things* that the electron is a spherical nucleus which itself is subject to the FitzGerald contraction, to extend his argument to cover the null result of this experiment. But the special assumptions which he makes were all made with an eye towards the result, namely, the failure of experiment to give a positive evidence of motion through the æther. They were hypotheses *ad hoc,* and to that extent they were really, though the name had not been invented, applications of the principle of relativity. It cannot be shown from the form of the general equations of the electromagnetic field alone that null effects are to be expected, for the experimental results most certainly extend into regions where these equations are insufficient; they do not cover, for instance, the whole theory of refraction, of conduction of electricity, or of the exterior configuration of a given body.

It is for this reason that the hypothesis that the *fact of motion relative to the aether must be for ever concealed*, becomes of importance as a general and independent principle. It becomes a criterion and a guide, for example, as to the form that is to be chosen for the constitutive relations which connect the electric force and displacement, the magnetic force and induction, and the current in moving bodies. It leads us to the conclusion that the Newtonian conception of a constant mass needs some revision if the hypothesis is true, and at this point comes into touch with the experiments on the variation of the apparent inertia of a negative electron with its velocity, and in fact is here confirmed.

But although experiment suggested and has so far confirmed the validity of the hypothesis, yet two serious objections are raised against it. The first is that it conflicts with our simplest ideas as to the measurement of space and time, and the second is that it abolishes the æther as a unique and objective medium, the seat of all electrical activity. In a succeeding article an attempt will be made to indicate what position in regard to these two very important points the adoption of the hypothesis requires us to take.

E. CUNNINGHAM.

DR. J. REYNOLDS GREEN, F.R.S.

THE announcement of the death of Dr. Reynolds Green, on June 3, will have been received with unfeigned regret by all his scientific fellow-workers, whether botanists or physiologists. For those who, like myself, have known him throughout his career with a considerable degree of intimacy, regret amounts to a deep sense of personal loss. It is some consolation to me to have this opportunity of writing a few words in appreciation of him who was so closely associated with me first as pupil, then as collaborator, always as friend.

Joseph Reynolds Green came up to Cambridge in 1880 as a scholar of Trinity College, in which year he also took the B.Sc. degree in the University of London. In 1883 he duly gained a first-class in the Natural Sciences Tripos, part i., a success which was followed in 1884 by a first class in part ii., his subjects being botany and animal physiology. After taking his B.A. degree, there was some uncertainty as to which science he would pursue, but his inclination was to botany, his first scientific contribution being a paper on the glands of the Hypericaceæ, which appeared in the Journal of the Linnean Society, 1884. Circumstances, however, led him to devote himself for a time to animal physiology; in 1885 he was appointed senior demonstrator in that subject by the late Sir Michael Foster, a position which he held for two years. Nevertheless, he was engaged, during that time, in botanical research, the results of which were published in two papers read before the Royal Society: the one on the proteid substances in latex (Proc. Roy. Soc., 1886); the other, larger and more important, on the changes in the proteids in the seed which accompany germination (Phil. Trans., 1887), in which he confirmed for the Lupin the discovery by von Gorup-Besanez (1874) of a proteolytic enzyme in the seeds of the Vetch. These papers indicated the direction in which his future work was to lie.

His appointment, in 1887, as professor of botany to the Pharmaceutical Society of Great Britain enabled Green to devote himself entirely to botany, and this he did whole-heartedly. During the twenty years that he held this office, his literary output was voluminous. The first twelve volumes of the *Annals of Botany* (1888–98) contain a number of papers by him on various points in the biochemistry of plants; and he contributed several articles to the first series (1894–8) of *Science Progress*. Perhaps the most important of his investigations during this period were, that on the germination of the seed of the castor-oil plant (Proc. Roy. Soc., 1890), in which he detected the fat-splitting enzyme (lipase), a subject to which he returned years afterwards (Proc. Roy. Soc., 1905); that on the germination of the pollen-grain (Phil. Trans., 1894), proving the presence and activity of amyloclastic enzymes both in the grains and in the tissue of the style; and that on the action of light on diastase (Phil. Trans., 1897), where the effect of light on diastase is investigated and it is shown that whereas the red and the blue rays favour the formation of the enzyme, the green, the indigo, the violet, and especially the ultra-violet rays destroy it; and the striking suggestion is made that "vegetable structures have a power of absorbing radiant energy, which is not connected with the presence and activity of chlorophyll."

In addition to these papers and articles, Green found time to write three considerable books: "A Manual of Botany based upon that of the late R. Bentley, 1895–6; "An Introduction to Vegetable Physiology," 1900; and "The Soluble Ferments and Fermentation," 1899. All three went on to a second edition, but the last was the most successful and important of them; a German translation of it, by Windisch, was published. They are characterised by the lucidity of exposition that he possessed in a high degree.

Owing to failing health, Green resigned his professorship in 1907, and undertook the less onerous duties of the Hartley lectureship on vegetable physiology in the University of Liverpool, still, however, residing at Cambridge. He was commissioned by the delegates of the Clarendon Press, Oxford, to write a continuation, published in 1909, of Sachs's "History of Botany" (1530–1860), to bring the record up to the end of the nineteenth century; a difficult task which he performed with as much success as the circumstances permitted. He became so interested in work of this kind that he planned, and I believe completed, a history of botany in England, which, unfortunately, has not yet been published.

A few personal details in conclusion. Green proceeded M.A. at Cambridge in 1888, D.Sc. in 1894; he became a Fellow of the Linnean Society in 1889, and was elected to the Royal Society in 1895. He was president of Section K (botany) at the Belfast meeting of the British Association in 1902; and in the same year he was elected Fellow of Downing College, Cambridge.

S. H. VINES.

NOTES.

THE June conversazione of the Royal Society will be held on Tuesday next, June 16.

SIR WILLIAM OSLER, F.R.S., Regius Professor of Medicine in the University of Oxford, has been elected a foreign Associate of the French Academy of Medicine.

PROF. A. LACROIX, professor of mineralogy at the Paris Natural History Museum, has been elected permanent secretary of the Paris Academy of Sciences in succession to Prof. Van Tieghem.

DR. R. S. LULL, professor of vertebrate palæontology at Yale, will this summer conduct another western expedition from the Peabody Museum for the purpose of securing skeletons of prehistoric horses.

THE council of the Royal Society of Arts, with the approval of the president, H.R.H. the Duke of Connaught, has awarded the Albert medal for the current year to Chevalier Guglielmo Marconi, "for his services in the development and practical application of wireless telegraphy."

THE Khedive has conferred the third class of the Order of the Medjidieh upon Mr. W. Lawrence Balls on the occasion of his retirement from the service of the Egyptian Government. This is, we believe, the first decoration given for agricultural work since the foundation of the Department of Agriculture in 1910.

PROF. H. HERGESELL, of Strassburg, has been appointed to the direction of the Royal Prussian Aeronautical Observatory at Lindenberg, near Berlin, and desires that communications intended for him or the International Commission for Scientific Aeronautics, of which he is president, should be addressed to the

Königl. Preussisches Aeronautisches Observatorium Lindenberg (Kreis Beeskow).

Dr. F. J. Becke, professor of mineralogy in the Imperial and Royal University of Vienna (Austria); Dr. T. C. Chamberlin, professor of geology in the University of Chicago (Illinois), U.S.A.; Dr. F. J. Lœwinson-Lessing, professor of mineralogy and geology in the Polytechnic Institute of St. Petersburg (Russia); Dr. A. P. Pavlow, professor of geology and palæontology in the Imperial University of Moscow (Russia); and Dr. W. B. Scott, professor of geology in the Princeton University, Princeton (New Jersey), U.S.A., have been elected foreign members of the Geological Society of London. Dr. P. Choffat, Geological Survey of Portugal, Lisbon, and Dr. Charles R. Van Hise, president of the University of Wisconsin, Madison (Wisconsin), U.S.A., have been elected foreign correspondents of the society.

The Elliott Cresson medals have been presented by the Franklin Institute, Philadelphia, this year as follows:—To Prof. Karl P. G. Linde, for his scientific investigations of the processes of refrigeration and the liquefaction of gases, and his inventions of machinery for applying these processes in the manufacture of ice and for the purposes of cold storage; to Dr. E. F. Smith, for his work in the field of electrochemistry, his contributions to the literature of chemical science, and his service in university education; to Prof. J. M. Eder, for his researches in photochemistry and his contributions to the literature of that science and of the graphic arts; to Mr. Orville Wright, for the work accomplished by him, at first together with his brother Wilbur and latterly alone, in establishing on a practical basis the science and art of aviation.

The Dorset Field Club intends this month to reopen the Dewlish Trench, about which there has been much discussion. This trench is in chalk, and is filled with fine sand below, and above by loam with bones of *Elephas meridionalis*. An open gash in soft chalk is so exceptional as to lead the Rev. Osmond Fisher to suggest lately that this must be an artificial elephant-trap; other geologists take it to be natural, though formed in some way not clearly understood. Should it prove to be an elephant-trap, several interesting questions are raised. *Elephas meridionalis* is not definitely known as Pleistocene; it occurs in Pliocene or pre-Glacial strata, and seems to have disappeared from Britain at the incoming of the cold. The association of this elephant with man would be a new point, though some supposed "eoliths" have been picked up near the trench. The infilling of the trench is peculiar. The bones belong to several individuals, and if they were trapped it seems to have been for the meat alone, for the tusks remain. Below the elephant-layer is fine dust-like desert sand, with highly polished flints. The circular sent to us by the Earthworks Committee of the Dorset Field Club shows that the work will be properly done. Mr. Charles Prideaux will camp on the spot, which will be carefully enclosed. The trench will be opened from end to end, until the undisturbed chalk-bottom is reached. All fossils and flints will be carefully collected and examined. The Dorset Field Club proposes to visit the trench on June 30.

The *Armauer Hansen*, of Bergen, a vessel of about fifty tons, but replete with all up-to-date apparatus for the investigation of the hydrography of the sea, started from Plymouth on June 2 on a two months' cruise in the Atlantic. The scientific work of the cruise will be conducted under the direction of Prof. Helland-Hansen, director of the Marine Biological Station at Bergen, and he will also have the advantage of the advice of Prof. Fridtjof Nansen, who, with his son, accompanies the party. The vessel, which is only some 25 yards in length, is worked partly by motor and in part by sail. It has been built to stand any weather, being constructed somewhat after the plan of the Norwegian lifeboats. From Plymouth the *Armauer Hansen* will proceed in a south-westerly direction across the Atlantic for approximately five hundred miles, and then return eastward to Lisbon, where the party expects to arrive in a fortnight. From Lisbon the vessel will proceed to the Azores, and thence return, according as time permits, either by way of the English Channel or along the west coast of Ireland and Scotland, and *viâ* the Faröes to Bergen. During the cruise a detailed survey will be made in regard to such hydrographical factors as temperatures, currents, circulation, salinities, dissolved gases, penetration of light, points which in due time will prove to be not only of theoretical but of practical importance. The boat is manned by a crew of six and the scientific staff consists of Messrs. Grein, Grondahl, Gaarder, and Birkeland. The expenses of the cruise have been partly defrayed by the Nansen Fund.

By the death of the great French electrometallurgist, Paul Héroult, which took place at Antibes on May 9, at the early age of fifty-one, modern metallurgical industry loses a figure of outstanding importance. Héroult's fame chiefly rests on the invention of the process which bears his name for the manufacture of aluminium, an invention which had the effect of creating a new industrial metal, but his work in the field of the electrometallurgy of steel, though less widely known, is scarcely less important. Héroult's early interest in aluminium was concerned with aluminium-bronze, for which it was supposed there might be a ready market, and his first patent in this direction was taken out in 1886. It was in 1888 that he tackled the problem of making pure aluminium, in conjunction with Dr. Kiliani, and in that year were founded the first aluminium works at Neuhausen. Héroult's master-discovery was that of a suitable solvent for alumina, and this he found in fused cryolite, $3NaF.AlF_3$. The establishment of the works of la Société Electrométallurgique française at Froges (Isère), followed soon after that of the Swiss works, and since then the manufacture of aluminium by the Héroult process has become an established industry in most of the chief countries of Europe. Héroult commenced his work on the manufacture of steel in the electric furnace in 1899, and in the following year a small trial furnace of 3000 kg. capacity was working successfully at La Praz. The part Héroult has since played in the development of the electrometallurgy of steel may be conveyed most convincingly by merely stating that more Héroult furnaces are in use than are those of any other type; no fewer, indeed, than thirty-one, consuming some 19,000 kw., out of a total of 129 furnaces taking 50,000 kw., a capacity, moreover, which will be doubled in the near future, when the large 22–25-ton Héroult furnaces now in course of erection will be put into operation. If the foundations of the new method have now been firmly laid, to Héroult can justly be accorded the chief share of the credit.

In the February issue of the Proceedings of the Academy of Philadelphia for 1914 Mr. H. N. Wardle describes and figures two specimens of the diminutive mummified human heads prepared by the Jibaro (Jivaro) tribes dwelling in the eastern valleys of the Andes around the head-waters of the Amazon, by whom they are called *tsantsa*. Although such mummies have been known to science since the year 1862, when one was described by Dr. Moreno-Maiz, in the Bull. Soc. Anthrop., Paris (vol. iii., p. 185), they are still so rare that each merits a separate description. Of the two specimens described by Mr. Wardle, one (figure here reproduced) has been recently acquired by the Philadelphia Academy; it was formerly in the Museum Umlauf, Hamburg. The second is in the private collection of Mr. S. Castner, of Philadelphia, by whom it was purchased at a sale in 1903, and wrongly stated to have come from Oceania. Accounts vary as to the method by which these heads—of which two examples are shown in the Natural History Museum—were prepared.

A "Tsantsa," or diminutive mummified head of a Jibaro Indian. From Proc. Ac. Nat. Sci. Philadelphia.

To vol. xliii., part 4, of the Rec. Geol. Surv. India, Dr. G. E. Pilgrim contributes an article on the correlation of the Siwaliks with European mammaliferous horizons, in which it is concluded that while the topmost conglomerates of the former (with remains of camels and Indian buffaloes) represent the Upper Pliocene, the Bugti beds correspond to the Lower Burdigalian or Upper Aquitanian of Europe. Several forms, including two genera of machærodont tigers, and a genus of bear, are described as new.

Papers recently received on American faunas include one, by Mr. N. de Witt Betts, on the birds of Boulder County, Colorado (Univ. Colorado Studies, vol. x., no. 4); a second, by Mr. M. M. Ellis, on the fishes of Colorado (*ibid.*, vol. xi., no. 1); and a third, by Dr. P. S. Welsh, on the North American worms of the family Enchytræidæ (Bull. Illinois State Lab. Nat. Hist., vol. x., art. 3). The last-named group, which has hitherto received scant attention from naturalists, comprises sixteen genera and many species (inclusive of several described as new by Dr. Welsh), ranging over America and Europe, and reported to occur in Siberia, N. Africa, and New Zealand, but mainly restricted to cold areas, including even glaciers. Allied in many respects to ordinary earth-worms, in others the Enchytræidæ display affinities with the lower Oligochæta.

Mr. L. Walmsley has written a concise illustrated "Guide to the Geology of the Whitby District" (Horne and Son, Whitby, price 1*s*.), which should be useful to the hundreds of summer visitors who go forth with hammers in their hands. We hope that this edition will be appreciated, since we are promised in that case a subsequent one on a somewhat fuller scale. A reference to the colour-printed drift map of the Geological Survey, Sheets 35 and 44, would seem desirable. The variety of Ammonite types, St. Hilda's "headlesse snakes," is well brought out in the illustrations.

Dr. C. Diener's description of the "Triassic Faunæ of Kashmir" appears as one of the folio memoirs of the Geological Survey of India ("Palæontologia Indica," vol. v., Mem. 1, price 4*s*. 4*d*.). In dealing with the fine series of ammonites, the author abandons his genus Danubites in favour of Waagen's Xenodiscus, of which several species are described. A new genus, Kashmirites, is introduced, allied to Xenodiscus and Sibirites. The Ceratite group is well represented in the zones corresponding to the European Muschelkalk. Although a passage is proved from the Tethys (Mediterranean) marine region to that of the Himalayas, communication was evidently restricted throughout the whole Triassic period, so far as cephalopoda are concerned.

The connection between ice and fog is well known, and within little more than two years both have taken a disastrously heavy toll of life. Both conditions are necessarily frequently referred to in the monthly meteorological charts of the North Atlantic published by the United States, Germany, and this country. Among the chief causes of ocean fog formation (quoted in the American charts) may be mentioned the mixture of masses of moist air of different temperatures, and the direct cooling of moist air coming into contact with icebergs or cold northern waters. The Meteorological Office chart for June points out that near the Banks of Newfoundland the risk from fog is about eight times greater in midsummer than in midwinter; in May and June the fog zone stretches from Europe to America. The German chart for June states that up to May 19 numerous bergs and extensive icefields were met with to the east of the Newfoundland Banks between 47° and 50° W. longitude. In some cases bergs were sighted so far south as 42° N. latitude. The southerly advance of drift ice usually ceases about the middle of June, and by the middle of July the ice limit rapidly recedes.

A SUMMARY of the weather for the past spring as shown by the results for the thirteen weeks ended May 30 has been issued by the Meteorological Office. The mean temperature for the period is above the average in all districts of the United Kingdom, the excess being as much as 3° in the north-east of England, 2·5° in the east of England, and from 1°–2° in all other districts. The south-east and the east of England are the only districts where the absolute temperature rose to 80°. The rainfall is only 85 per cent. of the average in the north-east of England, and the only other districts with a deficiency of rain are the midland counties with 97 per cent. of the average, and the north-west of England with 99 per cent. of the average. The greatest excess of rain is 140 per cent. of the average in the south-east and south-west of England, and 131 per cent. in the Channel Islands. In the east of England the rainfall is 113 per cent. of the average, and in the north of Ireland 112 per cent. The absolutely largest rainfall is 10·82 in. in the north of Scotland, and 10·21 in. in the south-west of England, whilst the least is 4·26 in. in the north-east of England. The mean temperature at Greenwich for the spring months, March, April, and May is 49·7°, which is 1·7 in excess of the average; it is precisely the same as in the spring of last year, but 1·8° colder than in 1912.

No. 5 of vol. iii. of the Memoirs of the Department of Agriculture in India contains a study by Messrs. F. J. Warth and D. B. Darabzett, of the "Fractional Liquefaction of Rice Starch." It is shown that different specimens of rice show very different behaviour as regards the temperature at which liquefaction of their starch occurs. The method adopted consisted in estimating the percentage of starch liquefied at intervals of temperature of 5°. The results published in this paper show that the cooking quality of rice is distinctly correlated with its starch quality, and that there is also a certain parallelism between these features and the ease with which the different samples undergo disintegration by dilute alkalis. Some kinds of grain contain a variety of starch which is far more resistant than that of others.

THE importance of the mineral elements in the nutrition of farm animals has recently begun to receive recognition, and Research Bulletin No. 30 of the Agricultural Experiment Station of the University of Wisconsin, by Messrs. E. B. Hart, H. Steenbock, and J. G. Fuller, deals with the relation of the supply of calcium and phosphorus in the ordinary farm feeds to the animals' requirements; from the data considered a number of interesting conclusions are drawn. Grains in particular are deficient in calcium but rich in phosphorus, and rations wholly made up of grains will supply to the growing animal an amount of calcium dangerously near the critical level of intake. The supply of calcium also becomes an essential factor when continuous and high milk production are aimed at, and the diet must be suitably adapted in order to achieve this result, if necessary by the artificial use of calcium carbonate and phosphate.

PROF. IGNAZIO GALLI has published in the memoirs of the Pontifical Academy of the *Nuovi Lincei*, of Rome, a fourth memoir on globular lightning, and on its effects on trees and on grass. The memoir quotes in an uncritical manner an enormous number of reputed instances of lightning of globular form, most of which were recorded by wholly untrained observers, and extend over several centuries. Prof. Galli adds little to the facts collected by Flammarion and other writers. He directs attention to observations which seem to show that the lightning stroke following a spiral path is usually *dextrorsum* in horse-chestnuts, cherry-trees, apple-trees, and willows, but *sinistrorsum* in plum-trees, whitethorns, oaks, and sycamores; in beech-trees sometimes one way, sometimes the other. He discusses whether this is due to inherent spiral structure of the fibre of the wood or to some special gyratory property of the discharge. Most of the observations are of such ancient date that critical discussion of them is out of the question.

AN article in the Paris *Matin* was referred to by the Paris correspondents of several London daily papers last Saturday. It relates to some interesting experiments in wireless telephony carried out by Captain Colin, of the French Navy, who has been at work on the subject for some years in collaboration with Lieutenant Jeance. The details of the apparatus are not given, but it would appear that some improvement has been made in the direction of maintaining steady and continuous oscillations at the transmitting end. Speech, it is stated, has been transmitted from Paris to Finisterre, a distance of 300 miles, and a type of field apparatus with a mast about 90 ft. high has, it is said, been developed, which can be unloaded from a motor-car and set to work by a crew of six men in twenty-one minutes, and will transmit without difficulty over a distance of from 60 to 120 miles.

THE most interesting communication brought before the meeting of the Bunsen Gesellschaft für angewandte physikalische Chemie at Leipzig on May 21–24 was a paper by K. Fajans on the different atomic weights of lead. According to a line of reasoning simultaneously developed by Fajans and by Soddy during the last few years, lead derived from radium and lead derived from thorium by the loss of five and six atoms of helium respectively should be identical except in atomic weight. Throughout the past year Dr. Fajan's assistant, Dr. Lembert, has been working in Richard's laboratory at Harvard in order to obtain atomic weights of as high a degree of trustworthiness as possible. The differences established by the series of determinations announced at the meeting by Fajans amount to about 0·3 per cent. (Soddy and Hymans read a paper before the London Chemical Society on May 7, in which they likewise described experiments which showed a difference between thorite lead and ordinary lead of 0·5 per cent.) The keen discussions which followed the various papers showed quite clearly that the chief subjects at present of general interest to physical chemists in Germany are: (1) applications of the theory of quanta; (2) the nature of sorption; (3) the photochemistry of gases; and (4) the generalisation made by Bredig and Snethlage, in extension of the work of numerous other investigators, as to the parallelism between the catalytic activity of undissociated acids and their strength. A striking illustration of the wide bearing of some of the (at first sight) apparently uninteresting special investigations were afforded by E. Cohen's paper on unstable modifications of pure metals. His results demonstrate that most measurements hitherto made of physical constants of metals, such as density and Hall effect, have not been carried out on chemical individuals, but on unknown mixtures of these unsuspected metastable forms, so that they require to be revised.

WE have received the catalogue of microscopes, etc., made by C. Reichert, of Vienna, for which Messrs. Angus and Co., of Wigmore Street, are the British agents. Since the foundation of the firm in 1876, 55,000 microscopes have been produced. The catalogue comprises microscope stands of varying complexity, achromatic and apochromatic objectives, comparison eye-pieces and other accessories, polarimeters, and microtomes. Both workmanship and prices compare favourably with those of other well-known makers.

WE have seen the March issue of *Gendai no Kagaku* (*Scientific Gazette*)—a new Japanese journal similar to NATURE, printed in Japanese characters. It has been designed to meet an increasingly felt need for a serious and authoritative general organ for the growing body of men of science and students of research in Japan. The journal is well printed, and its contents are written and edited by professors of the Tokyo and Kyoto Imperial Universities. The issue before us contains special articles on insects and their pupæ, the relation between zoology and medicine, great men of science, and inertia and relativity; reviews of books; notes and abstracts classified under the various sections of astronomy, physical geography, biology, chemistry, and applied sciences; meteorological reports and ephemerides of celestial phenomena, and proceedings of societies. In the last-named section no fewer than eight learned societies of Tokyo are represented. The illustrations include a collotype portrait of Prof. Simon Newcomb, and a star chart, to be continued serially. The publication is to be welcomed as a sign of the increase of interest in scientific subjects in Japan.

PROF. W. BATESON's work on "Mendel's Principles of Heredity" has been translated into German by Alma Winckler, and published with an introduction by Prof. R. von Wettstein, under the title, "Mendel's Vererbungstheorien," by Mr. B. G. Teubner, Leipzig and Berlin, at the price of 12 marks. Another translation just received from the same publisher is "Pflanzenanatomie," translated by Dr. S. Tschulok from the fifth Russian edition of Prof. V. I. Palladin's work. We have also received a volume entitled "Theory of the Atom," by Prof. T. Mizuno, of Kyoto Imperial University, Japan, published by the Maruzen Co., Ltd., Tokyo, but as it is in Japanese characters it is intelligible only to a few European men of science, and no useful purpose would be served by reviewing it in these columns.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 11. 9h. 0m. Jupiter stationary.
,, 15h. 33m. Uranus in conjunction with the Moon (Uranus 1° 48′ N.).
12. 12h. 32m. Jupiter in conjunction with the Moon (Jupiter 0° 44′ N.).
18. 20h. 0m. Mercury at greatest elongation (24° 55′ E.).
21. 18h. 55m. Sun enters Sign of Cancer. Summer commences.
22. 12h. 24m. Saturn in conjunction with the Moon (Saturn 6° 1′ S.).
25. 21h. 9m. Venus in conjunction with the Moon (Venus 0° 46′ S.).
27. 15h. 58m. Mars in conjunction with the Moon (Mars 0° 36′ N.).

COMET 1914*b* (ZLATINSKY).—*Astronomische Nachrichten*, No. 4737, publishes the elements and ephemeris of the comet discovered by Zlatinsky (1914*b*) calculated by Mr. Crawford and Miss Levy. These agree very closely with those computed by Prof. H. Kobold, and published in this column on May 28 (p. 330). A further communication to this number by Prof. E. C. Pickering states that Dr. Perrine cables the similarity of Zlatinsky's comet with comet 1790 III., Caroline Herschel. The following ephemeris has been calculated by Dr. Ebert, and appears in *Das Weltall* for May:—

	R.A. h. m. s.	Dec. ° ′
June 11	8 55 57	+1 17·9
13	9 1 51	−0 50·3
15	9 7 1	2 45·3
17	9 11 37	4 26·1
19	9 15 44	−5 56·2

FIREBALLS.—Mr. W. F. Denning writes that on June 3 at about 10.30 p.m., and June 4 at 11.7 p.m., brilliant meteors were observed by Mrs. Fiammetta Wilson, of Bexley Heath. The former had a path from 80°+46° to 33°+59°, which it traversed in 6⅔ seconds, carefully timed by stop-watch. The latter was placed near the N.W. horizon, close to the stars Castor and Pollux, and seemed to explode with a flash brighter than Venus.

The fireball of June 3 was seen at Bristol, and a comparison of the pair of observations shows its height to have been about fifty-one to forty-eight miles. It flight was almost horizontal from a radiant near the S.E. horizon in 281°−25°. Path about 160 miles long, velocity twenty-five miles per second. It began over The Wash and ended over the county of Durham.

The radiant point in Sagittarius represents a well-known June and July meteoric shower.

Further observations of the large meteors seen on June 3 and 4 are required. Many observers must have noticed them in the north of England.

OBSERVATIONS OF NOVÆ.—Prof. E. E. Barnard continues to keep watch on the behaviour of novæ with the large Yerkes instrument after they have passed out of reach of ordinary telescopes, and communicates some further observations concerning the Novæ Geminorum 1 and 2, and Nova Persei 2. With regard to Nova Geminorum 2 (Enebo), he states that this nova seems to have changed its focus and general appearance back again to the normal. This rapid change to the abnormal and back to the normal focus suggests a resemblance to that of Nova Persei 2 (Anderson), this object having been examined frequently by him. In the case of Nova Geminorum 1 (Turner), which was examined in February of this year, the star was faint but not difficult. The estimation of its magnitude would make the object 16·8; it is still fading, but Prof. Barnard hopes to be able to follow it with the 40-in. refractor for another year at least.

REPORT OF THE CAPE OBSERVATORY.—The report of his Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the year ending 1913 has just been issued. In the eight pages we are introduced to a large programme of work which has either been accomplished or is in progress. Among the observations with the reversible transit circle were 6948 meridian transits, 1330 observations of meridian marks, 6670 determinations of zenith distance, 690 nadir determinations, etc. The 8-in. transit circle has had a self-registering micrometer mounted at the eye end, and worked in conjunction with a special chronograph. The combination is for the determination of stellar parallax, and after preliminary trials a regular programme of observations was commenced. The heliometer has been employed on the major planets at the times of opposition, and 177 observations were made. The Victoria telescope was chiefly occupied in securing stellar spectra for radial velocity determinations, and 151 plates were obtained. During a portion of the year the spectroscope was dismounted and photographs were taken of Jupiter and the Galilean satellites near the epoch of quadrature of the planet. The astrographic telescope was for the main part used for the magnitude plates, while with the photoheliograph 634 negatives of the sun, taken on 311 days, were secured for inclusion in the Greenwich series. The report concludes with statements concerning the reductions, publications, time signals, and personal establishment.

THE ADMINISTRATION OF ANÆSTHETICS.

DEATH under anæsthesia is always a most lamentable occurrence, and these accidents fall into three categories: first, those which no human skill can avert, for example, in unsuspected cases of status lymphaticus; secondly, those due to want of knowledge on the part of the medical practitioner; and, thirdly, those which occur in the practice of unqualified persons. The second class of cases can be met by ensuring that instruction in anæsthetics is an essential part of medical and dental education, and this has been in a measure secured by recent alterations in the regulations of examining bodies. The deaths which occur under the third heading can only be prevented, and the public protected, by making the administration of anæsthetics by unqualified persons illegal. There is reason to believe that such accidents occur more frequently than reports in the public Press would lead one to suppose, but statistics are obviously difficult to obtain. A Government measure, regulating the administration of anæsthetics and prohibiting their use by unqualified persons, was suggested by a Departmental Committee of the Home Office some years ago, but this has never come to fruition, and private bills introduced into Parliament have shared the usual fate of private bills. The question, however, has been kept alive by the energy of Sir Frederick Hewitt, Prof. Waller, and others, and year by year fresh evidence has accumulated showing the urgent need of legislation; since the introduction of cocaine the evil has increased. We are glad to learn that the council of the British Association, at its last meeting, passed a resolution (inspired by the anæsthetic committee of the association) by a large majority, asking the Government to introduce a measure limiting the use of these dangerous drugs to properly qualified persons, or to those acting under their immediate supervision. The council is to be congratulated on thus fulfilling one of the objects of the association, namely, to attempt to remove disadvantages of a public kind. We can only trust that Parliament, having got the burden of its three large measures off, or nearly off, its shoulders, may now find time to do so some really useful work.

WIRELESS TELEGRAPHY RESEARCH.

THE report of the committee appointed by the Postmaster-General "to consider and report how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony," has just been published (Cd. 7428, price $1\frac{1}{2}$*d.*). We propose to deal later with the scheme put forward for the appointment of a national committee for telegraphic research, and the establishment of a national research laboratory in connection with it; and here limit ourselves to a statement of the conclusions arrived at from a consideration of the research work undertaken in the United States and Germany. (1) That it is desirable to establish some body or institution to initiate and control research in matters of general principle which cannot conveniently be investigated in departmental laboratories, to coordinate so far as may be the work now undertaken by the Post Office, Admiralty, and War Office, respectively, in connection with experiment and research in wireless telegraphy, so as to prevent work undertaken by one department overlapping work undertaken by another, and thus secure economy, and to discuss any difficulties arising in practice. (2) That the work now being done by the departments should be continued and extended, opportunities being also found for the departmental engineers to carry out such experiments and tests as may be approved by the body or institution to be established for the purposes above referred to, and may require high power and service conditions. (3) That it is desirable to establish a research laboratory (as distinguished from the existing departmental laboratories and service stations), in which research work bearing on the practical needs of the services should be carried out under the guidance of the body or institution above referred to. (4) That though the work to be undertaken by the new body or institution and in the new laboratory, the establishment of which we recommend, will principally concern wireless telegraphy, it is undesirable to exclude therefrom the problems of ordinary telegraphy and telephony.

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE eighth annual conference of the Association of Teachers in Technical Institutions was held at the Central Technical School, Liverpool, during Whitsuntide, and was very successful from every point of view.

In the course of his presidential address Mr. P. Abbott reviewed the recent developments in educational and professional matters. He submitted that the education of the adolescent was the first problem of the century, and one closely associated with the future of technical education. The State must recognise its responsibility for the complete education of the youth; it had so far failed in its duty by bringing the education of the child to a dead end at the age of thirteen or fourteen. It was not with our elementary education that the fault was to be found. There must be an extension of the age of full-time instruction to fourteen or fifteen, followed by compulsory part-time instruction to eighteen or twenty, aided by compulsion on employers to diminish the hours of work to a corresponding degree. The Denman Bill now before Parliament would be welcomed as a step forward, giving, as it does, power to the local authority to extend the leaving age to fifteen, to compel attendance at continuation classes to sixteen, to restrict hours of child labour, and to restrict street trading for young people. The Bill was defective in its permissive qualities, but represented an advance in educational reform.

We were in the midst of a movement to free technical education from the thraldom of external examinations the results of which, as the President of the Board of Education had felicitously expressed it, might be called "snap-judgments." The true function of an examination should be *one* of several factors—attendance, home work, laboratory work, etc.—by means of which the teacher could satisfy himself that the pupil had worked satisfactorily through the course. It is not the examination that matters: it is the *course* that is all-important, and the training received during the course.

In an age of continuous progress and change it was essential that technical education should possess elasticity, flexibility, and adaptability. If teachers were expected to mould their work to the requirements of a cast-iron syllabus—such as obtained wherever external examinations prevailed—these properties could not exist.

It was to the credit of the Board of Education that it had taken the initiative by abolishing some of its own external examinations. Some remain, and it was difficult to see what good was obtained by their retention. Unfortunately, the abolition of the Board's examinations had induced the growth of certain unions of institutions so far beyond their original and ostensible purpose, that they were seeking to impose their systems of external examinations upon technical institutions and to deprive them of that freedom so necessary for the proper development of their work. The examinations of such bodies were the worst kind of external examinations; and these unions, which jealously exclude the practising teacher from their councils, had become the attractive centres of those who still cling to the fallacy that external examinations are an integral part of technical education. No system of external examination prevails in America, Germany, France, Austria, or Switzerland, and yet their technical education is so highly efficient that the results cause apprehension in our British industries.

Papers on internal examinations were read by Prof. Haldane Gee, and Messrs. Harrison, Bower, and Small. Mr. W. Hewitt, the director of technical education for Liverpool, read an interesting paper on a retrospective glance at the rise of scientific and technical education in England.

Resolutions welcoming the formation of the Teachers' Register and approving the report of the Departmental Committee on the superannuation of secondary and technical teachers were carried unanimously, as were those welcoming the Denman Bill, and advocating the formation of advisory boards composed of representatives of teachers, local authorities, inspectors, employers, and employees, to draw up courses of work, and to assist institutions in the conduct of their internal examinations.

DEVONIAN OF MARYLAND.[1]

THE three volumes before us comprise, in the first volume, an introduction on the general relations of the Devonian (67 pp.), an account of the Lower Devonian strata, their stratigraphy (122 pp.), and their palæontology (322 pp.), with descriptions of all the fossils, whether new or previously known.

The second volume treats of the Middle and Upper Devonian, the stratigraphy of the former occupying 114 pp. and its palæontology 224 pp. The Upper Devonian stratigraphy occupies 196 pp., and the descriptions of the fossils 165 pp. The third volume is filled with plates, seventy-three in number, showing all the species which have been found in the Devonian of Maryland.

It will be seen, therefore, that a large amount of space is given to the descriptions and figures of fossils. The stratigraphy is described from a purely scientific point of view; there is no chapter on economics, but perhaps that part of the subject is reserved for a special memoir.

The introductory chapter includes a section on the palæogeography of the Devonian in North America, with eight maps of successive phases, contributed by Dr. Ch. Schuchert, but this seems somewhat out of place; for the Appalachian portion of Maryland is very narrow, and includes but a very small part of the long Devonian outcrop in the range, so that as the author himself says, "if restricted to maps of the State, the palæogeography of Maryland would teach very little." In other words, the State does not furnish any basis for such restorations; moreover, Dr. Schuchert's method of restoring ancient lands and seas are very different from those employed in Europe.

The authors of this memoir review the classification of the Devonian in America; they divide the Lower Devonian into two stages, the Helderberg (limestones) and the Oriskany (sandstone and shale), this series being only about 700 ft. thick. The Middle Devonian consists mainly of shales, in three divisions—the Onondaga Shale, the Marcellus Shale, and the Hamilton Beds—the average thickness being 1600 ft. The Upper Devonian consists of two different types of sediment, a lower marine type, which they call the Jennings formation, and an upper "continental" type, called the Catskill formation. The former is composed of variously coloured shales and sandstones, and is from 4000 to 4800 ft. thick, the latter of red and grey standstones and shales, from 2000 to 3800 ft. in which no fossils have yet been found.

From the above it will be seen that the Appalachian Lower Devonian is a concentrated and largely calcareous formation, the Middle Series of a normal varied composition, while the Upper (though marine)

[1] "Maryland Geological Survey." Middle and Upper Devonian. Text. Pp. 720+vi plates. Lower Devonian. Text. Pp. 560+xvi plates. Devonian. Plates xvii-lxxiii. (Baltimore: The Johns Hopkins Press, 1913.)

must have been deposited near a large area of land. In this connection it is noticeable that beds of coraliferous limestone are repeatedly called "coral-reefs," without a tittle of evidence that they ever formed true coral-reefs.

Dr. Schuchert correlates the Lower Devonian fauna with that of the Konieprus Limestone (F^2) of Bohemia. It is rich in corals, echinoderms, bryozoa, and brachiopods, with a fair number of mollusca and trilobites. Most of the species are different from those of the European equivalent, and even the form hitherto known as *Pentamerus galeatus* is now distinguished as *coeymanensis*. The orthids, Dalmanella and Rhipidomella, are specially abundant in the Helderberg limestones.

In the Middle Devonian, corals and bryozoa are rare, and no echinoderms are found, so that the fauna has a different aspect from that of the European series, consisting chiefly of brachiopods and pelecypod mollusca, with a few gasteropoda, cephalopoda, and trilobites. It is noteworthy that Bactrites and Agoniatites make their appearance.

The Upper Devonian fauna is more interesting, not only because it includes species of Tornoceras and Bactrites, Buchiola and Styliolina, but also because some of the species are European, such as *Spirifer disjunctus*, *Atrypa reticularis*, *Buchiola retrostriata*, and *Schizophoria striatula*.

In conclusion, it may be mentioned that the figures of fossils are well executed, and that the whole work is creditably produced, though owing to the use of thick paper the volumes are very bulky and heavy. Such tomes may be liked in America, but in this country we prefer more handy and less weighty productions.

A. J. JUKES-BROWNE.

THE ROYAL OBSERVATORY, GREENWICH.

ON Saturday last, June 6, the Astronomer Royal presented his report at the annual visitation of the Board of Visitors of the Royal Observatory. The report refers to the year commencing May 11, 1913, and exhibits the state of the observatory on May 10 of the present year.

Reference is first made to the new building, which has been erected in the magnetic enclosure in the park for the purpose of housing a set of modern instruments for recording the variations of the magnetic elements. The significance of the building consists in the fact that it is composed of a thickly walled outer room, containing an inner room well insulated by a considerable air-space, the constancy of the temperature of the latter being controlled by electric heaters regulated by a thermostat. After reference to the principal moveable instruments at the observatory or on loan from or to the observatory, we are informed that a silver-gilt inkstand presented to Sir G. B. Airy in 1852 by the River Dee Company has been presented to the observatory by his son, Mr. Osmund Airy. A portrait of Sir William Huggins has also been presented by Lady Huggins, and Sir William Christie has given one of himself.

Turning to the astronomical observations we find that with the transit circle the following observations have been made:—

Transits	16,423
Determinations of collimation and level error	311 and 632
Circle observations	16,455
Determinations of nadir point and reflection observations of stars (included in the number of circle observations)	607 and 417

With the altazimuth the following observations have been made:—

Meridian transits	1862
Meridian zenith distances	1031
Extra meridian observations	72
Determinations of collimation and level error	252 and 184
Determinations of nadir point ...	152

The travelling-wire micrometer has been used throughout the year for the determination of right-ascensions, and it is intended to replace the present eye end of the transit circle also by a travelling-wire micrometer which is now under construction.

The excess of the number of observations of R.A. in relation to those of N.P.D. is due to the inclusion in the working list of a number of faint and bright stars for comparison with the transit circle, and the determination of the magnitude equations of the observers with the latter instrument. The N.P.D.'s having been observed with the new printing micrometer, an interesting table is given of the comparison with Newcomb's catalogue for different periods.

The mean error in right ascension of the moon's tabular place for 1913 is given as −0·81s. from meridian observations and −0·87s. from extra-meridian observations of the moon's limb, and −0·81s. from meridian observations of the crater Mösting A. The transit circle gives 0·832s. Attention may be directed to the great increase in recent years of the mean tabular error of the moon's longitude. From 1883, when Newcomb's empirical correction was introduced into the Nautical Almanac, the values (all reduced to the same equinox) are:—

	″		″
1883	−0·03	1899	−2·18
1884	−0·16	1900	−2·69
1885	−0·09	1901	−2·77
1886	−0·11	1902	−3·15
1887	+0·21	1903	−3·08
1888	+0·76	1904	−3·16
1889	−0·38	1905	−5·29
1890	−0·27	1906	−5·91
1891	+0·72	1907	−5·96
1892	+0·79	1908	−5·97
1893	−0·06	1909	−6·41
1894	−1·20	1910	−7·85
1895	−1·47	1911	−8·34
1896	−1·68	1912	−9·79
1897	−2·77	1913	−11·8
1898	−3·03		

After a short reference to the observations made with the Cookson floating zenith telescope and the equatorial observations, mention is next made of the 28-in. refractor which has been employed on all known double stars showing appreciable relative motion, and a few other stars for special reasons. The measures have consisted of 105 pairs with separation less than 0·5″; 110 pairs with separation between 0·5″ and 1·0″; 123 pairs with separation between 1·0″ and 2·0″; 125 pairs with separation greater than 2·0″.

While the early publication of the mean results is communicated each year to the Royal Astronomical Society, the measures from 1893 to 1915 will be formed into one catalogue, each separate observation being given. This catalogue will contain 3000 double stars and notes on the more interesting stars.

The work with the Thompson equatorial has been confined to parallax and photometric determinations, the 26-in. refractor being used throughout. For the parallax observations an exposure of the same plate at two different epochs, approximately six months apart, is required. During the year the first exposure has been given to 292 plates, and a second exposure to 219 plates. The work of the measurement of these plates is well advanced, and in the report the parallaxes of seven stars have been determined and indicate the high standard obtained.

Photographic magnitudes determined with the 6-in. astrographic triplet are next dealt with and we notice that great progress has been made with the work in hand. The same may be said of the work on the photographic magnitudes with the 26-in. refractor on the Kapteyn areas and the central regions of the Franklin-Adams charts, and of the astrographic equatorial for the determination of photographic magnitudes of stars in the Greenwich section of the Astrographic Catalogue by comparison with the standard magnitudes of the stars round the north pole.

With regard to heliographic observations, photographs of the sun were secured on 258 days, and of these 515 have been selected for preservation. Photographs were received from the Royal Observatory, Cape of Good Hope, to March 1, 1914; from Dehra Dûn, India, to December 7, 1913, and from Kodaikanal, India, to December 13, 1913, the series for the year 1913 being made up from the four contributing observations. The mean daily spotted area of the sun has been eight millionths of the sun's visible hemisphere during 1913, as against thirty-seven in 1912, and sixty-four in 1911. The appearance of a moderately large spot in March pointed to the end of this very low minimum of solar activity.

An expedition is in preparation to proceed to Minsk, in Russia, to observe the total solar eclipse visible on August 20–21. The programme is stated to be similar to that attempted in Brazil in 1912.

Coming now to the magnetic observations, we find that the mean values of the magnetic elements for 1913 and three previous years from observations in the magnetic pavilion are as follows:—

Year	Declination W.	Horizontal force in C.G.S units	Dip (3-inch needles)
	° ′		° ′ ″
1910	15 41·2	0·18532	66 52 37
1911	15 33·0	0·18529	66 52 6
1912	15 24·3	0·18528	66 51 46
1913	15 15·2	0·18514	66 50 27

In 1913 there were no days of great magnetic disturbance; one day was classified as of lesser disturbance. The new magnetic house being now complete, will shortly receive the new instruments to be set up in it; these are briefly described in the report.

A short *résumé* regarding the present state of the meteorological reductions is followed by a summary of the weather conditions for the period covered by this report.

The mean temperature for the year 1913 was 50·5°, or 1·0° above the average of the seventy years, 1841–1910. For the twelve months ended April 30, 1914, the mean temperature was 50·8°. During the twelve months ended April 30, 1914, the highest temperature in the shade (recorded on the open stand in the enclosure of the magnetic pavilion) was 87·1° on June 17. On eight days the highest temperature in the shade equalled or exceeded 80°, but five of these days occurred in May and none in July. The lowest temperature of the air recorded during the same period was 19·9° on January 24.

The mean daily horizontal movement of the air in the year ended April 30, 1914, was 288 miles, which is four miles above the average of the previous forty-six years. The greatest recorded daily movement was 759 miles on April 6, and the least seventy-nine miles on October 24. The greatest recorded pressure to the square foot was 26·0 lb. on December 26, and the greatest velocity in an hour forty-four miles on March 16 and April 6.

The number of hours of bright sunshine recorded during the twelve months ended April 30, 1914, by the Campbell-Stokes instrument, was 1446 out of a possible 4457 hours, giving a mean proportion of 0·325, constant sunshine being represented by 1. This is not far below the average amount, a very fine April nearly counterbalancing an exceedingly dull July.

The rainfall for the year ended April 30, 1914, was 22·30 in., being 1·82 in. less than the average for the period 1841–1905. The number of rainy days (0·005 in. or above) was 164. January with 0·50 in. was the driest month, and March with 3·93 in. the wettest.

The sections dealing with the chronometers, clocks, and time service indicate a considerable state of activity. Thus under the first-named, it is stated that in the year ended May 10, 1914, the average daily number of chronometers and watches being rated was 712, the total number received was 2094, the total number issued was 2110, and the number sent to repair 934.

An interesting table is that showing the times sent out from the time-distributing centres, namely, the Eiffel Tower and Norddeich, as recorded at the observatory. These signals are regularly received and compared with the Greenwich time. The results to May 10, 1914, using the impersonal micrometer of the altazimuth as the standard for the personal equations of the Greenwich observers, are as follows:—

Observer	No. of obs.	Signal late on G.M.T.	Personal equation	Mean discordance
		s.	s.	s.
		Eiffel Tower.		
L (Morn.)	412	0·002	—	±0·110
W B (Morn.) ...	539	0·044	—	±0·114
L—W B	375	—	−0·057	±0·060
Rhythmic signals	175	0·041	—	±0·065
W B (Night) ..	256	0·050	—	±0·122
		Norddeich.		
L (Morn.)	336	0·016	—	±0·225
W B (Morn.) ...	526	0·060	—	±0·209
L—W B	300	—	−0·051	±0·075
Rhythmic signals	—	—	—	—
W B (Night) ...	242	0·062	—	±0·214

In the Astronomer Royal's general and concluding remarks he states:—"The excellent spirit which animates both the permanent and temporary staff of the observatory is shown by the large number of observations and by the extent to which measurements, computations, and other work are kept up to date. Attention may be directed to the improvement in the altazimuth observations by the introduction of the impersonal micrometer and new eye-end to the instrument, to the success which has so far attended the observations for stellar parallax, and to the changes which are in progress in the magnetic observations."

The reader should be reminded that the above brief summary of the Astronomer Royal's report to the Board of Visitors only conveys a very general idea of the work carried on during the past year. The original report should undoubtedly be read to gain a proper indication of the great amount of work summarised in the brief but concise paragraphs which compose it.

THE DEVELOPMENT OF THE AEROPLANE.[1]

DR. GLAZEBROOK dealt mainly with the work of experiment and scientific research in the development of the aeroplane, referring especially to the work of Dr. Stanton, Mr. Bairstow, and their colleagues at the National Physical Laboratory. The experiments are conducted in an air channel in which a

[1] Abstract of the second Wilbur Wright Memorial Lecture, delivered before the Aeronautical Society of Great Britain on May 20, by Dr. R. T. Glazebrook, C.B., F.R.S.

model of the aeroplane or the part of the aeroplane the behaviour of which it is desired to study, is supported on the arm of a balance by means of which forces and moments acting on it, when a current of air is produced in the channel by a suitable fan, can be measured. The velocity of the air current is measured by a Pitot tube, and a constant distribution of velocity across nearly the whole of any section of the channel is secured by special arrangements. At the National Physical Laboratory there are now two channels, one 3 ft. square and the other 4 ft. square, in daily work. A third channel, 7 ft. square, is nearly complete. The results of lift and drift experiments on the same aerofoil, when measured by different observers in the two channels recently, were found to be practically identical.

As to the means of stepping from the model to the full-scale aeroplane—the force on a surface due to the wind may be written as KSV^2, where S is the area of the surface, V the speed of the wind, and K a quantity which for two similar surfaces similarly placed is approximately a constant, independent, that is, of the velocity and the area. Experiment proves that the force is not strictly proportional to the square of the speed. Curves are given in the paper showing that as a result of determinations of the lift and drift coefficients for an aerofoil at speeds changing from 10 to 50 ft. per sec., it appears there is a growth in the coefficients as the speed increases. Lord Rayleigh has pointed out that if K be not constant for similar surfaces it must be expressible as a function of VL/v, where V is the velocity of the current, L some linear dimension of the surface, and v the kinematic viscosity of the air. From experiments on model and full-sized aerofoils, it appears that at the highest value of VL yet reached in the model experiments the value of the lift/drift ratio is somewhat less than for the full-scale experiments, but that values for the coefficients found from the 50 ft. per sec. observations in the channel do not differ greatly from those belonging to the actual machine. This point will be checked more fully when the large wind channel is complete.

A method of checking the accuracy of the model work is to calculate the forces on an aerofoil from the pressure distribution. This has been done at the N.P.L., and in the case of the lift the agreement is complete; in the case of the drift the calculated results are too low, which is to be expected, as in the calculations, air friction on the surface is neglected. Reference is made to the fact that in designing a wing, the shape of the upper surface is more important than the lower.

The results are given of measurements made on a model of a monoplane of ordinary type, of the forces and moments produced in the plane of symmetry when the attitude of the machine changes, but without yawing; and the forces and moments produced by yawing without alteration of the angle of pitch, so that flight is horizontal. Curves are also given of the pitching moment of a biplane model for various settings of the elevator. As the result of experiments of this kind it appears that the wash from the main planes reduces the moment on the tail very greatly. The curves given show that on comparing the moment about the C.G. of the machine as calculated from a knowledge of the shape and position of the tail, the elevators being at a small positive angle, with the measured moment, the latter is of only half the calculated amount. Further study is being made to determine the best position for the tail.

Mathematical Investigation into the Stability of an Aeroplane.—Mr. Bairstow and Mr. Nayler, of the National Physical Laboratory, have recently determined the coefficients for the monoplane model previously mentioned, and used them to determine its motion in a variety of circumstances, and some account of their results is given. The effect of a single horizontal gust in the direction of motion is first taken. The results of the calculations are given in curves which show that the particular machine when struck by a horizontal gust loses longitudinal speed at first, and after passing through a series of changes of velocity, settles down after a few oscillations in less than a minute to its original speed relative to the wind. The initial loss of speed is accompanied by an increase of normal velocity; the machine rises for a fraction of a second, acquiring a rapid positive angular velocity, but these motions soon change sign and die away like the horizontal velocity. The nose of the machine rises for 5 sec., at first rapidly, then more slowly, and the pitching oscillation thus started dies down in the same manner as the others, the motion being stable.

The effect of a single downward gust in the plane of symmetry is next described. The curves show that relatively to the air the machine acquires an upward velocity which dies down in about one second and is followed by the slow oscillations as before. The changes in the other quantities are shown in the curves, and the motion of the machine can be traced as before. By combining the results, the effect can be found of a change in the direction of the wind or an alteration in the propeller thrust or the position of the elevators.

Two cases of lateral disturbance are next considered. This motion in the particular machine dealt with is unstable. Curves are given showing the effect of a side-wind striking the machine on the left-hand side. The machine quickly picks up the velocity of the wind After about 7 sec. the relative sideways motion is very small, but it gradually increases, and after 40 sec. has reached some 9 per cent. of the original disturbance. Unless the controls are altered the side-slipping will continue to increase. A large angular velocity of roll is started almost immediately and at first this gradually dies down, but after 6 sec. or so the divergence term begins to tell and the rolling increases unless checked by the pilot. The velocity of yaw is at first negative, the machine yaws to the left, a motion opposite to that which corresponds to the bank. After a time this is reversed, and the yaw and bank increase together.

In another series of curves is recorded the effect of sudden banking. After 40 sec. the angle of banking exceeds its original value by 63 per cent., while the velocity of yaw also increases rapidly, as does the side-slipping velocity, which takes place in the negative direction. Thus the machine turns to the right, increasing the angle of banking, and side-slipping inwards and downwards at the same time.

In the descriptions above it has been assumed that the controls are not touched, but a comparison of the curves referred to above with the curve obtained when the effect of warping or of turning the rudder are considered, shows that the control of such an unstable machine is not easy.

Messrs. Bairstow and Nayler have in this way solved the following problems:—An aeroplane is in flight in the air. (1) At a given instant the wind changes either in speed or direction, or both, and the new conditions remain for a time steady. The motion of the aeroplane is determined by the curves given in the paper: (2) at a given instant the controls of the aeroplane are altered. The ensuing motion is defined by other curves: and (3) by a suitable combination of the curves the effect of change of wind and change of control occurring simultaneously can be determined.

If the motion of an aeroplane when moving through successive gusts is analysed for a few minutes it can be determined whether either the safety of the machine or the comfort of the passenger requires a modification of the stability.

Messrs. Bairstow and Nayler have analysed the motion for a complete minute of an aeroplane moving over the ground with steady speed of 60 ft. per sec. in a wind as registered on an open-scale record of velocity changes, obtained at Kew Observatory. The velocity of the wind ranged from 11 to 33 ft. per sec., the average being 20 ft. per sec. Curves are given in the paper showing the changes in the wind velocity during the minute, and the variation in the velocity of the air relative to the machine during the same minute. The similarity of the two curves is marked. Curves are also given which show that if the speed of the aeroplane over the ground in still air is taken as 80 ft. per sec., its speed relative to the gusty air (as shown in the anemogram referred to) varies from 70 to 94 ft. per sec. The aeroplane has not time to respond to the rapid changes in the wind. While the changes in the actual horizontal velocity of the aeroplane are considerable, they occur much more slowly than in the wind-velocity curve; the minor alterations are wiped out; a rise in the wind velocity causes a fall in the velocity of the machine, provided the changes are sufficiently prolonged, but a very rapid rise and fall of the wind velocity is scarcely noticeable. It is assumed that the controls have not been touched while this motion is in progress. Curves are, however, also given, showing the effect of altering the elevator during the gust, and it appears that the elevator can without difficulty be so manipulated as practically to cancel the effect of the gust. The curves deal only with the longitudinal motion of the machine. Messrs. Bairstow and Nayler are now engaged in the similar problem for the lateral motion of the machine, and when this is completed, propose to attack in the same way the motion of a biplane of standard form.

The practical outcome of work of this kind is shown in the Army aeroplane R.E.1. The importance of this machine arises from the fact that it was designed to have inherent stability as the result of calculations based on scientific experiments, such as have been described in this lecture.

The Advisory Committee for Aeronautics has given much attention lately to the consideration of the stresses to which a machine may be subject in flight. The normal stress coming on any part of the machine is usually taken as that which it has to bear in steady horizontal flight, produced, that is, by a loading equal to the weight of the machine; if the breaking stress is N times this, N, according to present usage, is called the factor of safety. A machine, however, in its ordinary use may frequently have to carry a load much in excess of what it bears in steady horizontal flight. It would be more consistent with engineering practice to estimate what is the maximum stress the machine in its daily use may have to bear, and then take as the factor of safety the ratio of the breaking stress to this maximum stress. The factor of safety would thus take account of imperfections of workmanship or of material, not of varying load. If the maximum stress to be allowed for is taken to be equal to a loading N_1 times the weight of the machine (the normal loading in horizontal flight), and the breaking stress is n times this, then the ratio of the breaking stress to that occurring during steady horizontal flight is nN_1. This is called N, so that $N=nN_1$, and N, not n, is the factor of safety as ordinarily but mistakenly used in aeronautics.

The value of N has been determined by calculation and, in some cases, by direct experiment, for a number of machines, and appears to range from 3 to 7 or more. It is shown that a sudden gust may cause stresses on a machine four times as great as those occurring in steady horizontal flight at maximum speed. Another cause of serious sudden increase in loading is rapid flattening out after a dive, and calculation shows that stresses from eight to ten times those due to normal loading may be experienced due to this. From a consideration of these figures it is clear that it is essential to make an effort to strengthen machines so that N_1, the load factor, is at least six. Giving n the value of two (although an engineer would certainly think it too low for his work) the value of N would be twelve. There are great difficulties in attempting to reach so high a value at present, but it is not thought that the degree of safety specified is beyond reach.

THE METRIC SYSTEM.[1]

SINCE its introduction into the United Kingdom the metric system or question has had its ups and downs. Surely it is very curious that, although in 1862 a Parliamentary Commission recommended its introduction—a recommendation since repeated two or three times—and that a Bill was actually passed by the House of Lords, the metric system has not been adopted in this country. Why do people go on agitating? Well, the reason is the necessity for such a system. The facilities for intercommunication between various countries have a great deal to do with the continual agitation to introduce an international system of weights and measures. You may say the first person who put this down in black and white was James Watt. Writing to a friend in 1783 he said it was very awkward that the scientific results of workers in various countries could not be compared readily because of the measurements and weights being so different, and he proposed that they should agitate for the adoption of an international unit of weights and measures for scientific purposes. He wrote to French savants on the subject, and the result of the agitation was that in 1790 Prince Talleyrand brought in a Bill before the Legislative Assembly of France proposing that a Commission should be nominated to deliberate on this subject. It was a provision of that measure that the Royal Society of London and the French Academy should nominate the members of the Commission because it was agreed that the Commission ought to be an international affair and not merely a national one. The Royal Society would not agree to it because, as you know, England and France were at war at that time. Eventually, however, some other countries joined and constituted a Commission.

Another feature of the metric system was also suggested by Watt. He suggested that the unit of length should be cubed, a vessel constructed, filled with water at its greatest density, and that that should be the unit of weight. This cube should be the unit of capacity. In carrying out this idea insuperable difficulties have arisen of an absolutely mechanical nature, and so a kilogram is not any more a decimetre cubed and filled with water, but it is a piece of platinum kept in Paris at a certain temperature and at a certain barometric pressure. But the difference is very slight and does not affect the value of this co-relation between length, capacity, and weight. That is just the same as the standard of British measure—in fact, the real standards of English weights and measures were burned in 1835 in the Houses of Parliament and had to be reproduced afterwards as best they could. Secondary standards have now been made and have been distributed over the country, so that there is no danger of the standards being lost again.

After giving you this short history of the beginning

[1] From a report published by the Decimal Association of an address to the members of the Bradford Textile Society and of other Trade Organisations at Bradford, on November 17, 1913, by Mr. Alexander Siemens.

of the metric system, I wish to direct your attention to the greatly different circumstances of communication between the various countries from what formerly existed. The interchange of products between the various countries has increased very much, and it is to the interests of everybody that this interchange should be facilitated as much as possible. One of the greatest facilities is that the same weights and measures should be used everywhere. Now the real requirements of such an international system are two in number. One is that the measures and weights should have the same base ratio throughout; that means to say one pound in the English system should be 16 oz.; one ounce should be 16 drams; one foot 16 in.; one yard 16 ft., and so on. That would be a system with the same base ratio throughout. Only 16 is not a good one. I am, of course, aware that people say 12 is a good ratio because there are so many aliquot factors in 12—three times four, twice six—and that consequently 12 is handy. We are, however, faced by the fact that all people on earth who count, count by tens, and that has fixed the base ratio for any international system. If you attempt to put in any other ratio it would lead to confusion, and would not be so convenient. Therefore the base ratio of 10 is essential.

Now as regards a little more of the history of the metric system. In 1861 the old Federation of German States instructed a Commission to propose a national system of weights and measures, and after they had deliberated a short time they came back to the Federation and said, "We must say that the only sensible thing"—the only thing that would justify the upsetting of the old measures which were very confusing in Germany at the time—"the only reason for disturbing people and introducing new weights and measures can be to have an international system." At that time the metric system was not as widely introduced as now, and the Commission very carefully went into the question whether they should adopt the English or the French system of weights and measures. It must be remembered that the superiority of England at that time was still very overpowering. It was a little less so than in 1850, but still it was preponderant. The United States and Colonies of England all had the English system of weights and measures, so this Commission, consisting of sensible men, might have thought: "We will go with the majority of the manufacturing people and adopt their weights and measures." But when they saw the English weights and measures and went into them they unanimously decided that the metric system was the only possible international system. In the metric system there is the same base ratio and divisions everywhere, so you have to learn nothing. It is the same base ratio as you use in calculation. I remember in 1895 I had to give evidence before the Parliamentary Committee on Weights and Measures, and I handed in a German school-book on arithmetic. The Committee said, "How many pages are devoted to the metric system?" I showed them that on the back cover there was a note: "Remember a hectolitre is 100 litres; a kilogram is 1000 grams." The other things were so self-evident that it was considered unnecessary to say anything about them.

The Commission instituted by the old Federation of German States submitted their proposals to the Reichstag in due course; then came the year 1866, which delayed the introduction somewhat, but in 1868 the Act was passed that the metric system should be permissible from January 1, 1870, and compulsory from January 1, 1872. This disposes of the idea that the metric sytem can only be introduced in times of great commotion and so on. The date of the introduction of the metric system was decided upon long before anybody knew anything about the Franco-Prussian War, and was, therefore, introduced rather in spite of it than as a consequence of it. About the same time a Committee was appointed by the English Parliament to report on the introduction of the metric system, and after hearing all sorts of witnesses, they reported in 1862 that "in their opinion it would involve almost as much difficulty to create a special decimal system of our own as simply to adopt the decimal metric system in common with other nations." Furthermore, if we did so create a national system we would in all likelihood have to change it again in a few years into an international system owing to the increase of commerce and intercourse between nations."

More than fifty years ago the upshot was that the Committee said it would be a waste of energy to introduce a special English system because owing to the ever-increasing intercourse between nations the nations would be forced into the adoption of an international system whether they liked it or not. That is the real reason why the Decimal Association believes that the metric system is coming. It may be coming slowly, especially here in England—we cannot help that—but if you consider this point of view, that the international intercommunication is ever increasing, that the nations are becoming more and more dependent upon the produce of other nations, you will see—you must come to the conclusion that an international system of weights and measures is desirable, and that the refusal of such a system will impede progress.

What are the objections? The first that is made is to the decimal point. Owing to the base ratio being 10, and 10 throughout, there is no necessity to use a decimal point. For instance, anybody making drawings puts all the dimensions on the drawings in millimetres. That has two advantages. You need not put millimetres every time as you put feet and inches (′, ″), and it avoids a lot of misunderstanding if the drawing has not been very carefully figured. 1′ 1″ is often taken for 11 in., 2′ 4″ for 24 in., and all that sort of thing, but if you use millimetres you have not that difficulty.

The decimal point objection is really non-existent because you always take the next lower unit if you find that what you want to express is less than the higher unit, and that is generally quite sufficient. The second objection taken is the size of the unit. That really is an argument that shows into what desperate straits the opponents of the system have reached to find an objection, because I cannot for the life of me see that the metre and the yard are so very much different. Nor are a half-kilogram and a pound so very unlike each other.

The next thing is that the opponents of the compulsory introduction of the metric system say:—"Well, you have got all you want, you have permission to use the metric weights, the Board of Trade will verify them for you; they have the standards—so what more do you want?" That is just it. Do not these people see that in compelling manufacturers and traders to have two standards, one for home consumption, and one for dealing with metric countries, they handicap the manufacturers and traders here? And there is another point of view. There was a discussion before the Institute of Inspectors of Weights and Measures on the metric system; they are the people who go about among all the tradespeople and have to verify weights and measures, and they ought to know their business. One inspector said that "from the inspector's point of view there is one point which advocates should not favour, and that is the argument that the proposed general Act should be permissive. To have two sets of weights on the shop counter at the same time is not wise. We know what it would be to have a 14-lb. set and a kilogram set alongside the scale; the changes would be rung. The kilogram is very near the size of a 2-lb. weight; the metre near the length of the yard, and the litre near the size of a quart. With these facts before us the Act should, in our opinion, be compulsory."

These are the two arguments:—So long as it is permissive, people who deal with metric countries have to have two standards, and they are handicapped in that way, and poor people are exposed to the danger of being defrauded.

The last objection is on the ground of cost. In order to have a fair idea of what the cost would be it is preferable to examine in detail how various interests would be affected if the metric system were made compulsory after a transition period of, say, two years. Taking first the case of the retail trader with whom the general public have most of their dealings. I think it fair to quote an inspector of weights and measures who spoke in the discussion just now alluded to. He said:—"The change to the metric weights and measures would really be very little cost to the shopkeeper, but he does not realise that this is the case. The shopkeeper imagines that the whole of the weighing machines and weights have to be changed, and it is the weighing instruments that are the greatest factor with him. The effect so far as weights and measures are concerned is very small indeed. It does not cost much to change either his weights or his measures, and I refer to measures of length as well as to those of capacity. With regard to the changing of lever machines, we know as inspectors that it is a very common thing for a weighing-machine maker to have to change the whole of his steel-yard markings and to have to rub out the old markings and to mark it anew. In this case it would be a very easy thing to change the markings, which would also apply to platform machines and counterpoise weights. The cost would be very small indeed." We may take it on the authority of the persons whose business it is to know everything about the weights and measures of the retail trade that the cost of the change would not be an insuperable obstacle.

The next interest to consider is the textile trade. Here, the opponents of the system contend, the cost of the change would be appalling because all present looms would become obsolete and would have to be replaced by new ones adapted to produce metric widths of fabrics. I had better take that with the engineering trade, because about that the same is said. I say in reply to all these arguments, "What are you doing now? Are you not exporting to metric countries, are not engineers exporting to metric countries? Have not we in our works plenty of metric dimensions to manufacture to; have we ever found any difficulty in doing it? Have we ever had to introduce new machinery specially to make a metric thing? Never!" Even leading screws of English pitch can be used to produce screws of French pitch and *vice versâ*. You must put in one wheel with 127 teeth which makes the changes right. You will find you are absolutely correct. When before a Parliamentary Committee I was asked:—"Seeing that in the cotton trade the standard make is what is called 79 in., $37\frac{1}{2}$ yards, $8\frac{1}{4}$ lb. shirting—which is known all the world over—would it not in some way damage the reputation of the shirting if the figures had to be recalculated in all the markets of the world?" Well, at the time I had not sufficient time in which to make the calculation. What do you get when you recalculate? Seventy-nine inches are 2 metres within one-third of 1 per cent.; 37·5 yards are equal to 34 metres to within one-third of 1 per cent.; and $8\frac{1}{4}$ lb. are $3\frac{3}{4}$ kilograms. So you see you have been entertaining angels unawares. You have been manufacturing to metric measure. So why say it is difficult? The general experience is that wherever the metric system has been introduced it has at once been accepted as by far the simplest and easiest to comprehend, while it has the great advantage of being international, which is more and more necessary nowadays where the intercourse between countries is increasing.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At a meeting of the council on June 3, a letter from Sir George Kenrick was read, in which the offer was made to endow the Chair of Physics by placing in the hands of the treasurer securities the income from which should be used exclusively for the salary of the professor and objects intimately connected with the Chair, the latter to bear in future the title of the "Poynting Chair of Physics." It was proposed by the vice-chancellor, seconded by Principal Sir Oliver Lodge, and unanimously resolved: "That the council most gratefully accepts the generous offer of Sir George Kenrick to endow the Chair of Physics as a memorial to the late Prof. John Henry Poynting. The council desires to record its great appreciation of this act of munificence which follows so many other proofs of Sir George Kenrick's interest in the welfare of the University; . . . That the Mason Chair of Physics be henceforth called the Poynting Chair of Physics." It is proposed that the title of "Mason Professor" shall be transferred to another Chair specially associated with the late Sir Josiah Mason. We understand that the endowment will consist of securities of the value of 18,000*l*.

Under the will of the late Mr. J. Tertius Collins a sum of 200*l*. has been given to the University, the interest to be applied to the founding of a yearly prize or prizes for proficiency in chemistry or metallurgy or some kindred object in science.

Profs. Boulton, Cadman, and Turner have been appointed delegates to represent the University at the International Congress of Mining, Metallurgy, Engineering, and Practical Geology.

Dr. W. E. Fisher has resigned his demonstratorship in mechanical engineering on his appointment to the engineering department of the Staffordshire County Institute at Wednesbury.

CAMBRIDGE.—During the Michaelmas term Dr. Myers will give a course of lectures in the psychological laboratory on general and experimental psychology, considered especially in relation to medicine.

The Vice-Chancellor has published a summary of benefactions received by the University during the year ended December 31, 1913. The total amount of the benefactions acknowledged by Grace is 20,861*l*., and this included an anonymous gift of 10,000*l*. for the endowment of a professorship of astrophysics, 3661*l*. from subscribers to the Humphrey Owen Jones Fund, to establish a lectureship in physical chemistry, and 1500*l*. from Mr. C. E. Keyser, for the building fund of the new museum of archæology and of ethnology. In addition a sum of 2496*l*. has been received in smaller sums by the Cambridge University Association.

A studentship on the Arnold Gerstenberg foundation will be offered for competition in the Michaelmas term of 1915. The studentship will be awarded by means of essays; it will be of the annual value of nearly 90*l.*, and will be tenable for two years.

Prof. Nuttall has received the following benefactions with which to further the research work that is being conducted in the Quick Laboratory:—Sir Dorabji J. Tata, 250*l.*; Mr. P. A. Molteno and Mrs. Molteno, 400*l.*, of which the sum of 100*l.* is to help toward the expenses of publishing the scientific work from the laboratory; the advisory committee of the Tropical Diseases Research Fund (Colonial Office), 100*l.*, to serve as a stipend for a helminthologist, and 300*l.* to enable the Quick professor to send his assistant, Mr. E. Hindle, on an expedition to East Africa.

At the Congregation on May 30 new regulations for the diploma in anthropology received the approval of the Senate. Up to the present time, a candidate has had to keep certain terms and to prepare a thesis, and upon the latter if approved the diploma was awarded. The new regulations provide an examination as an alternative method of acquiring the diploma, and the examination is divided into parts, which may be taken separately or collectively. Moreover, the conditions of residence have been modified specially with reference to officers of various services, whether Colonial or other.

The new physiological laboratory was opened on June 9 by Prince Arthur of Connaught. The following honorary degrees were conferred in connection with the proceedings:—*LL.D.*: Prince Arthur of Connaught, Lord Esher, Lord Moulton of Bank, and Colonel Benson, master of the Drapers' Company. *Sc.D.*: Sir William Osler, Sir David Ferrier, Sir Edward Schäfer, and Prof. E. H. Starling.

LONDON.—Prof. J. Millar Thomson, F.R.S., is retiring at the end of this session from his position as vice-principal of King's College, London, and head of the chemical department of the college. Prof. Thomson's retirement marks not only the close of a personal connection with King's College as a member of its teaching staff for forty-three years, but also the end of an unbroken association with education in Great Britain where members of his family have held university professorships for a period of 130 years.

A lecture entitled "Some Problems in Cardiac Physiology" (being contributions to a study of the relations which exist between the various chambers of the Mammalian heart) will be given in the Physiological Laboratory of the University, South Kensington, S.W., by Prof. A. F. Stanley Kent, on Thursday, June 18. The lecture is addressed to advanced students of the University and others interested in the subject. Admission is free, without ticket.

WE learn from *Science* that Prof. Rudolf Tombo, jun., of Columbia University, died on May 22. He was known for his articles on university registration statistics, to which attention has been directed in NATURE on many occasions.

PROF. D. K. PICKEN, of Victoria College, Wellington, University of New Zealand, has been appointed master of Ormond College, Melbourne University. He has held the chair of mathematics at Wellington since 1907, and has taken a prominent part in the university reform movement in connection with which a New Zealand Parliamentary Committee held an inquiry last autumn. Arrangements are to be made through the High Commissioner for New Zealand for receiving applications in London for the professorship of mathematics (pure and applied) vacated by Prof. Picken.

A CUTTING from the Wellington *Evening Post*, New Zealand, of April 21, announces the award of a Martin Kellogg fellowship in the Lick Astronomical Department of the University of California to the Government Astronomer, Mr. C. E. Adams. The purpose of the fellowship is to provide opportunities for advanced instruction and for research to students who have already received the degree of Doctor of Philosophy or the equivalent, or to members of staffs of observatories. The fine instrumental equipment of the Lick Observatory offers opportunities to research students which can scarcely be equalled at other observatories, and the valuable experience derived from a stay there will be sure to imbue Mr. Adams with new energies and ideas for work on his return to New Zealand.

THE thirteenth annual congress of the Irish Technical Instruction Association was held at Killarney on May 26, 27, and 28, under the presidency of Principal Forth, of the Municipal Technical Institute, Belfast. The congress was very largely attended, delegates being present from practically every technical instruction committee in Ireland. The president, in his opening address, reviewed the developments which had taken place in technical instruction in Ireland during the past twelve months. He stated that on all hands there was a fixed determination to place the work of technical instruction in the most intimate and most helpful relationship to the industrial requirements of the country. He also dealt with some of the problems which await solution if technical instruction is to realise its fullest aims and ambitions; and he dwelt upon the decline which takes place in attendances at evening classes as the session progresses, giving some reasons why this wastage in numbers occurs, and indicating methods by which it could be checked. During the course of the congress an important address was given by Mr. T. P. Gill, and a number of valuable papers were presented, amongst which the following may be cited:—"The Technical Training of Skilled and Unskilled Workers in France and Germany," Dr. Garrett; "Technical Instruction for Small Holders," Mr. U. U. Humphrey; "Technical Instruction in the Woollen Industry," Mr. J. F. Crowley; "The Relation between Employers and Technical Instruction Committees," Mr. A. Williamson; "Co-operation between Counties, County Boroughs, and Urban Technical Instruction Committees," Mr. John Pyper. A paper on the problem of small industries, read by Mr. G. Fletcher, was illustrated by lantern slides, and also by kinematograph films which had been specially prepared to illustrate the working of machines for making embroidery. A highly instructive illustrated lecture was given by Mr. T. Macartney-Filgate, upon "An Industrial Survey of Ireland." The town of Larne, in the county Antrim, was fixed as the place of meeting for the congress in 1915.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—Sir William Crookes, president, in the chair.—Prof. W. **Watson**: Anomalous trichromatic colour vision. It is shown from the results of measurements made on some forty subjects that anomalous trichromates are sharply divided into two distinct classes, and two experimental methods of distinguishing these classes are described.—Dr. H. J. H. **Fenton**: Diformdiol-peroxide. The conditions of coexistence, and the mode of interaction, of hydrogen dioxide and formaldehyde are of some interest in connection with certain theories which have been advanced in order to account for the photosynthesis of carbohydrates in the living plant. During the course of some experiments in this direction, it has been found that, under appropriate conditions, these two substances combine to form a compound, $2H.CHO.H_2O_2$, which crystallises in large transparent plates or prisms. The general behaviour of the substance indicates that it is to be regarded as an "atomic" compound, in the ordinary sense of the term, rather than as a compound containing hydrogen dioxide of crystallisation.—Prof. H. E. **Armstrong** and E. E. **Walker**: Studies of the processes operative in solutions. XXIX.—The disturbance of the equilibrium in solutions by "strong" and by "weak" interfering agents. The effect of a large number of substances on the optical rotatory power of an aqueous solution of fructose has been measured and the views put forward in No. XXVI. of these studies with regard to the action of interfering agents have been confirmed and elaborated. "Strong" solutes, such as the sugars and metallic salts, increase the negative rotatory power of fructose, whereas "weak" solutes, such as the alcohols, ketones, and ethers, decrease it. The observed effect of the added substance ("the interfering agent") is regarded as the algebraic sum of two opposing factors:—(1) A diluent effect causing *dissociation* of hydrates and other complexes in solution; (2) an influence, opposite in effect to the first, depending on the reciprocal chemical attractive powers of the molecules of solvent and interfering agents promoting *association*. A simple mathematical expression involving these two factors has been developed by means of which (2) has been evaluated. This value is denoted by A. Thus calculated, A is found to be *very nearly proportional to the number of atoms of oxygen in the molecule*.—Prof. H. E. **Armstrong** and E. H. **Rodd**: Morphological studies of benzene derivatives. VII.—The correlation of the forms of crystals with their molecular structure and orientation in a magnetic field in the case of hydrated sulphonates of dyad metals.—Dr. E. E. Fournier **d'Albe**: A type-reading optophone. A description is given of a new construction of the "optophone," an instrument capable of translating light action into sound, and so making light recognisable by means of the ear. The new instrument is intended to enable totally blind persons to recognise and "read" ordinary letterpress by means of the ear. It consists essentially of a rapidly rotating disc perforated like a siren disc with several concentric circles of holes. A Nernst lamp is placed behind the disc with its filament stretched radially across the circles. The light, shining through the holes, gives regularly recurring flashes which, when of suitable frequency, can be detected by means of selenium and a telephone. An image of this line of intermittently luminous dots is thrown upon the type to be read, and the light diffusely reflected from the type is received on a selenium bridge. As each dot has a characteristic note, the sound heard in the telephone will vary with every variation in the reflecting power of the surface under examination. As the letterpress is moved on in the direction of the line of type, the sound changes rapidly with every change in the shape of the letters, and with some practice the latter can be "read" by ear. Type 5 mm. high can be thus read by means of an ordinary high-resistance telephone receiver. The effect becomes rapidly fainter as the type diminishes in size, but ordinary newspaper type is readable with the help of a highly sensitive Brown telephone relay.—L. H. **Walter**: An application of electrolytically-produced luminosity, forming a step towards a form of telectroscopy. The author has investigated the conditions under which it should be possible to make practical use of the luminosity of anodes of alloyed aluminium forming part of a "valve" cell arrangement. The alloy known as "duralumin" is found to give the best results, and with sodium tungstate solution as electrolyte, corrosion is practically eliminated when this alloy is used as the anode. The arrangement permits of the construction of an apparatus having a multiple anode, comprising a vast number of equal units in quite a small compass, each such unit being capable of being rendered luminous in any order or sequence desired and at a speed of some hundreds of times per second. Such an apparatus is capable of being employed as a receiver in phototelegraphy for the reproduction of pictures, etc., especially where these are received as electrical impulses.—P. G. **Nutting**: The axial chromatic aberration of the human eye.—L. V. **King**: The convection of heat from small cylinders in a stream of fluid, and the determination of the convection constants of small platinum wires, with applications to hot-wire anemometry.

Geological Society, May 27.—Dr. A. Smith Woodward, president, in the chair.—L. F. **Spath**: The development of *Tragophylloceras loscombi*, Sow. During his investigation of the Charmouth Lias, Mr. W. D. Lang collected fossil material with reference to its exact stratigraphical horizon. In the material *Tragophylloceras loscombi*, Sow., is represented by hundreds of specimens (chiefly young), and a study is given of the ontogeny of this ammonite. A number of specimens were dissected back to the protoconch, and their development traced in detail. Tables of measurements are given, and the other species of the genus are reviewed. The evolution of the suture-line was worked out in detail, and an important point brought out was the demonstration of a simple Psiloceras-like suture-line persisting to a late and post-constricted stage. The development of the suture-line in Psiloceras and Rhacophyllites is given for comparison.—Prof. P. **Marshall**: The sequence of lavas at the North Head, Otago Harbour, Dunedin (New Zealand). The North Head forms a precipitous cliff ranging from 300 to 530 ft. in height; it presents a clear section of a succession of lava-flows, including trachyte, trachytoid phonolites, kaiwekites, trachydolerites, and basalts. It appears that all the lavas were erupted from the same vent. Each sheet is covered by a bed of scoria, the coarseness of which proves that the centre of volcanic activity was not far distant. The lowest lava is a trachyte composed entirely of anorthoclase-felspar, and is succeeded by a phonolite in which sanidine is the conspicuous mineral. This is followed by a series of ten basalts of moderately basic character. The next flow is a kaiwekite, a lava of entirely different type, in which a hornblende allied to barkevikite forms the largest crystals. The basalts are succeeded by a phonolite which contains a few phenocrysts of anorthoclase. It is pointed out that in the lowest trachyte lime and magnesia are practically absent, but that the phonolite, although still deficient in these constituents, shows a distinct advance. The basalts as a whole are low in magnesia and above the average in alkalies. In the kaiwekite the alkalies advance, and there is an increase in silica and decrease in lime and magnesia. The higher basalts are somewhat richer in alumina and poorer in lime than those which occur lower in the section. The majority of the rocks fall into well-known and readily recognised groups. The porphyritic rocks of intermediate composition may have formed from an undifferentiated magma. The chemical composition of the intermediate lavas, as well as their mineral composition, would suggest that the original magma was that of essexite. It is important to note that in the Island of Tahiti, where there is a similar assemblage of alkaline and basic lavas, the reservoir has been laid bare by denudation and contains essexite as the dominant rock.

Paris.

Academy of Sciences, June 2.—M. P. Appell in the chair.—L. E. **Bertin**: The instability in steamers resulting from a collision. A statement of the advantages of horizontal watertight compartments.—E. L. **Bouvier**: New observations on viviparity in Australian Onychophores. It is shown that in spite of their name all the Ooperipatus are not oviparous.—M. **Considère**: Deformation and fatigue of reinforced concrete. Application to arched roofs. In the present state of knowledge it is impossible to calculate the total pressure at any given point of an arch.—Ph. **Barbier** and R. **Locquin**: The constitution of linalol. This alcohol was reduced by hydrogen at the ordinary temperature in the presence of platinum black. The resulting saturated alcohol was proved to be $(CH_3)_2.CH.(CH_2)_3.C(OH)(CH_3)(C_2H_5)$. This leads to the constitution for linalol proposed by Tiemann and Semmler.—J. **Guillaume**: Observation of the occultation of the planet Mars on May 30, 1914, made at the Observatory of Lyons.—J. **Guillaume**: Observations of the Zlatinsky comet (1914*b*) made at the Observatory of Lyons. Positions given for May 29 and 30. The comet appeared circular, about 2′ in diameter, and with a condensation round a nucleus of the 10th magnitude.—Georges **Meslin**: The inclination of the spectral lines and the equatorial acceleration of the solar rotation. A revision and correction of a formula of Cornu.—Patrick J. **Browne**: A direct formula for the solution of an integral equation of Abel.—G. **Armellini**: The problem of two bodies of variable masses.—Léon **Bouthillon** and Louis **Drouët**: Experimental study of the telephone receiver. The theory explaining the sound produced by the telephone simply by the transversal vibrations of the whole membrane is in good agreement with the results given by experiment.—G. Gouré de **Villemontée**: The propagation of electricity through paraffin oil. The influence of the thickness of the dielectric and of charges of very short duration.—G. A. **Dima**: The initial velocities of the photo-electric electrons. An apparatus for determining the initial velocities is figured and described in which the disturbing influences due to the reflection of light and the electrons are reduced to a minimum. The results for tin, zinc, aluminium, and magnalium are in agreement with those of Richardson and Compton.—M. and Mme. **Chauchard**: The action of monochromatic ultraviolet rays on amylase and lipase from the pancreatic juice. The amylase is attacked only by rays with wave-length smaller than 2800, the action increasing very rapidly as the wave-length diminishes. Lipase is destroyed by rays for which $\lambda = 3300$, the amylase not being affected.—Henri **Wohlgemuth**: Researches on the acyclic γ-halogen acids. These acids are obtained by the action of hydrochloric, hydrobromic, and hydriodic acids upon γ-valerolactone. The yield and purity of the products depend on details of manipulation which are given in full. Examples of the chemical behaviour of these acids are also given.—M. **Tiffeneau**: The migration of a methoxyl group in the course of the decomposition of a quaternary ammonium hydrate by Hofmann's method.—G. **Chavanne** and Mlle. J. **Vos**: The ethylenic isomerism of the acetylene di-iodides. A mixture of the two iodides was obtained by the action of acetylene upon iodine at 150°–160° C. From a study of the rate of elimination of hydriodic acid the *cis* configuration is attributed to the liquid isomer.—J. **Giraud**: New observations on the eruptive rocks of the south and west of Madagascar.—R. **Fosse**: The quantitative gravimetric analysis of urea in urine. The method is based on the insoluble compound formed by the interaction of urea and xanthydrol in acetic acid solution.—Emile **Fleurent**: Remarks on the diminution of the gluten in French wheats. Discussion of a recent paper by M. Balland on the same subject.—L. and M. **Lapicque** and R. **Legendre**: The alterations of the myeline sheath produced by various nerve poisons. Reply to a recent note by M. Nageotte.—C. **Levaditi** and A. **Marie**: The organism of general paralysis. Reasons are adduced for the view that there is a marked biological dissimilarity between the virus of general paralysis and that of cutaneous and mucous syphilis.—Pierre **Thomas**: The relations between the proteid substances of yeast with sucrase.—A. **Boutaric**: The influence of the polarisation of diffused light by the sky on the values obtained for the solar constant. The value of the solar constant varies inversely with the polarisation. This invalidates the usual extrapolation for deducing the solar constant.—J. **Deprat**: The tectonic accidents and the zones of crushing of the Black River (Tonkin).

HOBART.

Royal Society of Tasmania, April 15.—Sir William Ellison-Macartney in the chair.—Prof. A. **McAulay**: Quaternions applied to physics in non-Euclidean space. I.—An outline of methods, for elliptic space and for hyperbolic space, to be used in subsequent papers.—J. H. **Maiden**: Notes on some Tasmanian eucalypts. In a paper read before the society in 1912, R. T. Baker and H. G. Smith proposed certain species on the basis of essential oils obtained by distillation. The author criticises these species, and discusses the relations between essential oils (and other accessory characters) and the species which yield them.—H. Stuart **Dove**: Stone implements used by the aborigines of Tasmania. The author describes some examples of the disc-shaped stones, sometimes called "hammer-stones," found in the middens of the extinct aborigines of Tasmania, and discusses their use.

BOOKS RECEIVED.

The Care of Home Aquaria. By Dr. R. C. Osburn. Pp. 63. (New York: N.Y. Zoological Society.)

Biologen-Kalender. Edited by Drs. B. Schmid and C. Thesing. Erster Jahrgang. Pp. ix+513. (Leipzig and Berlin: B. G. Teubner.) 7 marks.

Die Kultur der Gegenwart. By A. Voss. Pp. vi+148. (Leipzig and Berlin: B. G. Teubner.) 5 marks.

Arithmetische Selbstständigkeit der europäischen Kultur. By Prof. N. Bubnow. Translated by Prof. J. Lezius. Pp. viii+285. (Berlin: R. Friedländer und Sohn.) 10*s.*

The Fixation of Atmospheric Nitrogen. By Dr. J. Knox. Pp. vii+112. (London: Gurney and Jackson.) 2*s.* net.

Luxor as a Health Resort. By W. E. N. Dunn and G. V. Worthington. Second edition. Pp. 36. (London: H. K. Lewis.) 1*s.* 6*d.* net.

Smithsonian Institution. U.S. National Museum, Bulletin 87. Culture of the Ancient Pueblos of the Upper Gila River Region, New Mexico and Arizona. by W. Hough. Pp. xiv+139+plates 29. (Washington: Government Printing Office.)

Les Hypothèses Cosmoganiques Modernes. By Dr. A. Véronnet. Pp. iii+171. (Paris: A. Hermann et Fils.)

La Forme de la Terre et sa Constitution Interne. By Dr. A. Véronnet. Pp. 32. (Paris: A. Hermann et Fils.)

Die Typen der Bodenbildung, ihre Klassifikation und geographische Verbreitung. By Dr. K. Glinka. Pp. iv+365. (Berlin: Gebrüder Borntraeger.) 16 marks.

Routledge's New Dictionary of the English Language. Edited by C. Weatherly. Pp. viii+1039. (London: G. Routledge and Sons, Ltd.) 3*s.* 6*d.*

Syllabus of the Lessons on Marine Biology and Navigation for Fishermen, given at the Marine Laboratory, Piel, Barrow-in-Furness, by the Lancashire and Western Sea-Fisheries Joint-Committee. Third edition. Pp. 105+xiv plates. (Liverpool: C. Tinling and Co., Ltd.)

Report for 1913 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. Pp. 376. (Liverpool: C. Tinling and Co., Ltd.)

The Microscopy of Drinking Water. By Prof. G. C. Whipple. Third edition. Pp. xxi+409+plates xix. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Nature in Books. By J. L. Robertson. Pp. 156. (Oxford University Press.) 2*s*.

Evolution and the Need of Atonement. By S. A. McDowall. Second edition. Pp. xx+183. (Cambridge University Press.) 4*s*. 6*d*. net.

Perception, Physics, and Reality. By C. D. Broad. Pp. xii+388. (Cambridge University Press.) 10*s*. net.

The Philosophy of Biology. By Dr. J. Johnstone. Pp. xv+391. (Cambridge University Press.) 9*s*. net.

Memoirs of the Geological Survey of Great Britain. Palæontology. Vol. i. Part 4. The British Carboniferous Producti: i., Genera Pustula and Overtonia. By Dr. I. Thomas. (London: H.M.S.O.; E. Stanford, Ltd.) 6*s*.

New Zealand Department of Mines. New Zealand Geological Survey. Palæontological Bulletin. No. 1. Materials for the Palæontology of New Zealand. By Dr. J. A. Thomson. Pp. 104. (Wellington, N.Z.: J. Mackay.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 11.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Bearing of Cytological Research on Heredity: Prof. E. B. Wilson.

ROYAL INSTITUTION, at 3.—Faraday and the Foundations of Electrical Engineering: Prof. S. P. Thompson.

FARADAY SOCIETY, at 8.—Presidential Address: Advances in the Metallurgy of Iron and Steel: Sir R. Hadfield.

FRIDAY, JUNE 12.

ROYAL INSTITUTION, at 9.—Some Aspects of the American Democracy: The Hon. W. H. Page.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Magnitude of η Argûs, and Discovery of a Close Companion to it: R. T. A. Innes.—A New Variable Star in Carina: H. E. Wood.—The Nebula HV 25 Ceti: Mrs. Isaac Roberts.—Comparison of Hill's and Le Verrier's Tables of Saturn: H. H. Turner.—An Area of Long-continued Solar Disturbance, and Associated Magnetic Storms: Rev. A. L. Cortie.—Correction to Note on Spectroscopic Binaries and the Velocity of Light: R. S. Capon.—Note on the Number of Components of a Compound Periodic Function: J. R. Dale.—Three Variable Stars in the Region of χ Persei: Dunsink Observatory.—Note on the Velocity of Light and Doppler's Principle: H. C. Plummer.—Dimensions of Saturn and his Rings, as Measured on Prof. Barnard's Photograph of 1911, November 19: the Transparency of Ring A and other Details shown on the Photograph: P. H. Hepburn.—Nebulæ seen on Mr. Franklin-Adam's Plates: J. A. Hardcastle.—Note on the Star 41 Virginis: E. W. Barlow. *Probable Paper*: Periodic Inequalities in the Epochs of Sun-spot Maxima and Minima: J. B. Dale.

PHYSICAL SOCIETY, at 8.—Note on the Connection between the Method of Least Squares and the Fourier Method of Calculating the Co-efficients of a Trigonometrical Series to Represent a Given Function or Series of Observations: Prof. C. H. Lees.—A Magnetograph for Measuring Variations in the Horizontal Intensity of the Earth's Magnetic Field: F. E. Smith.—The Atomic Weight of Copper by Electrolysis: A. G. Shrimpton.—Note on an Improvement in the Einthoven String Galvanometer: W. H. Apthorpe.

MALACOLOGICAL SOCIETY, at 8.—*Sulcobasis concisa*, Fer., and its Nearest Allies: C. R. Boettger.—Note on the radula and maxilla of *Orthalicus zebra*, Müller: Rev. E. W. Bowell.—(1) Invalid Molluscan Generic Names; (2) A New Cassid: T. Iredale.—The Relative Claim to Priority of the Names *Helix carduelis*, Schulze, and *Helix fruticum*, Müller: G. K. Gude.

SATURDAY, JUNE 13.

ROYAL INSTITUTION, at 3.—Studies on Expression in Art. II.: Right Expression in Modern Conditions: Sigismund Goetze.

TUESDAY, JUNE 16.

MINERALOGICAL SOCIETY, at 5.30.—Childrenite from Crinnis Mine, Cornwall, and Eosphorite from Poland, Maine: J. Drugman.—Sartorite: R. H. Solly.—Redeterminations of Nickel in the Baroti and Wittekrantz Meteorites: G. T. Prior.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Cheddar Man, a Skeleton of Late Palæolithic Age: Profs. C. G. Seligmann and F. G. Parsons.

ROYAL STATISTICAL SOCIETY, at 5.—Economic Relations of the British and German Empires: E. Crammond.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—An Expedition in Brazil: Hon. Theodore Roosevelt.

WEDNESDAY, JUNE 17.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Rainfall of the Southern Pennines: B. C. Wallis.—The Relation between Wind Direction and Rainfall: H. J. Bartlett.

THURSDAY, JUNE 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma Caprae* (Kleine). III: Development in *Glossina morsitans*; (2) Trypanosomes found in Wild *Glossina morsitans* and Wild Game in the "Fly-Belt" of the Upper Shire Valley; (3) The Food of *Glossina morsitans*; (4) Infectivity of *Glossina morsitans* in Nyasaland during 1912 and 1913: Sir D. Bruce, Maj. A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.—The Relation between the Thymus and the Generative Organs, and on the Influence of these Organs upon Growth (With a Note by G. U. Yule): E. T. Halnan and F. H. A. Marshall.—The Vapour Pressure Hypothesis of Contraction of Striated Muscle: H. E. Roaf.—The Validity of the Microchemical Test for the Oxygen Place in Tissues: A. N. Drury.—Man's Mechanical Efficiency: Prof. J. S. Macdonald.—The Colouring Matters in the Compound Ascidian *Diazona violacea*, Savigny: Dr. A. Holt.

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THURSDAY, JUNE 18, 1914.

STUDIES IN CANCER AND ALLIED SUBJECTS.

Studies in Cancer and Allied Subjects. Vol. i., *The Study of Experimental Cancer: a Review.* By Dr. W. H. Woglom. Pp. xi+288. Vol. ii., *Pathology.* Pp. vi+267. Vol. iii., *From the Departments of Zoology, Surgery, Clinical Pathology, and Biological Chemistry.* Pp. ix+308. Conducted under the George Crocker Special Research Fund at Columbia University. (New York: Columbia University Press. 1913.) Price 5 dollars net each volume.

BOTH the late Mr. George Crocker and his wife are reported to have died of cancer, and it may be recalled that an action was brought against Mr. Crocker for the recovery of a larger fee than had originally been agreed on for the surgical treatment of his wife. Thus, perhaps, it came about that Mr. Crocker left property to Columbia University which on partial realisation yielded somewhere about 300,000*l*. When he made his first donation for the investigation of cancer it was decided by those who had the matter in hand that, until a form of organisation was decided on, the money could best be expended by making grants to special workers in the departments of anatomy, zoology, surgery, pathology, and biological chemistry of Columbia University and the College of Physicians and Surgeons, New York.

Leaving vol. i., which is a monograph of xi+288 pp., by Dr. W. H. Woglom, for special reference later, the outcome has been the publication of sixty-six papers, which are collected in vols. ii. and iii. Of these papers twelve have not been published before, two are reprinted with expansion, and the rest are merely reprinted. Useful introductions are supplied to the papers by the professors in several departments (notably for zoology by Calkins, pathology by MacCallum, and bio-chemistry by Gies). In these introductions are set forth the points of view from which work has been directed. It is impossible to review the separate papers which have interest mainly for those actually engaged in similar work, who will be glad to have the papers in collected form.

Calkins and his fellow-workers have thrown their main strength in the direction of studying the phenomena of growth. He claims nothing could be more clearly demonstrated than the need for "team work," or the joint activity of pathologist, chemist, surgeon, clinician, biologist, from the results of two years' work. The underlying biological principle activating the researches on growth, and binding them into a consistent whole, was for Calkins "the physiological balance with self-regulation perfect in normal conditions thrown out of adjustment in cancer." Experiments were done on the effect of mutilating unicellular organisms. The thyroid and thymus glands were removed from rats, in order to study any possible consequences on the growth of tumours. The effects of chemical and mechanical irritation on mammalian tissues were studied, and extracts of glands injected with a view of observing any stimulating or inhibitive effects on the growth of transplanted tumours. Except the work on Paramœcium and Uronychia by Calkins himself, the experiments appear to have been conducted on too small a scale, and therefore it is not surprising they are for the most part stated to be negative or inconclusive and requiring expansion. They were admittedly conducted with a view to finding a point of attack, and it would be unfair to offer any criticism.

MacCallum's introduction is an interesting and very instructive review of present knowledge from the point of view that it is, perhaps, the poverty of our knowledge as to the factors which influence the energy of growth, and, indeed, growth in general, which is responsible for our inability to arrive at a satisfactory explanation of the development of tumours.

"The intolerance of the body for the disarrangement of its tissues is quite as wonderful as the growth of tumours and its study as illuminating." . . . "We must determine the causes of the growth of cells in general and the factors which underlie the increase in the energy of their growth as well as those which limit and hold it in check and render it practically impossible for normal tissue to continue its growth when displaced from its normal relations, or when in excess of the amount necessary for the body's needs. One side of this problem seems quite as important as the other; for in the development of an invasive tumour, we have the subversion of the ordinary laws which we assume to govern the proportions and proper relations of tissue growth."

These sentences embody points of view to which many will readily subscribe. It is unfortunate that the worker on the reactions leading to resistance to the growth of cancer and also of normal tissue (as the immunity reactions may be more correctly described), and who contributes no fewer than fourteen articles out of twenty-seven in vol. ii., had not diverted some of this industry to acquiring an accurate knowledge of the work of others so as to present their views correctly and himself avoid possible pitfalls in experimentation. His presentations of Ehrlich's atreptic or starvation theory of immunity have already called forth a vigorous protest on the part of the latter, but the misstatements are not corrected even by so much as a foot-note in the reprint in the present volume. Equally distorted statements are made by writing:—

"Bashford in his conceptions of immunity in cancers of mice and rats, denies that there is any direct influence of the host upon the inoculated cancer cell," and, to take only one other example, by asserting, "Bashford, Russell, and Da Fano, in describing the connective tissue and vascular scaffolding of the cancer cells, mean primarily the layer of fibrous tissue which surrounds and encapsulates the graft." On the contrary, the mere conception of a scaffolding for the cancer cells is intended to exclude this idea. What is meant is the penetration of the connective tissue and vascular cells between the cancer cells in such a way that the original arrangement is accurately reproduced in normal animals, but not in immunised animals. It would not have been worth raising the point now had it not been that the power of the cancer cells to elicit a specific form of stroma in the normal animal, and the paralysis of their power to do so in immune animals, are as yet the only trustworthy manifestations of the regulation of growth on which MacCallum rightly lays so much stress.

The tentative character of several of the papers is necessarily the result of the system of giving grants to workers for a particular line of research for a determinate period, and can only be avoided by adopting a system enabling men with wide knowledge and training to become intimately acquainted over a long period with such highly specialised work as cancer research has now become. Thus, MacCallum writes on the basis of the work criticised above on resistance to growth, that in an immune animal the portion of tumour implanted is surrounded by connective tissue as though it were a mere foreign body; and in spite of this abundant *stroma reaction*, or perhaps on account of it, the tumour fails to grow. The important facts are not only the surrounding of a graft in these circumstances by a connective tissue which *differs* from that in normal animals, but also the failure of the reacting tissues to penetrate into the graft so as to supply it with a new characteristic stroma or scaffolding. Similarly, the occasional finding that resistance has been produced after the inoculation of tissue from a strange species, or by autolysed tissues, or that it is possible to convey passive immunity, cannot be employed against the enormous preponderance of observations to the contrary.

It would be ungenerous not to admit that mistakes are unavoidable at the outset of inquiry planned as were these preliminary investigations of the Crocker Fund, and MacCallum himself generously acknowledges the progress being made by experiment in a brief summary. "When it became apparent that tumours of animals could be transplanted, and thus used in experimental studies, great hopes were roused, and, indeed, in the past years great things have been accomplished. When we sift the facts impartially, however, we find that we have still some of the greatest problems before us." Of the individual papers, reference may be made to those on the cultivation of tissues, in which due credit is given to Ross Harrison for initiating the method.

Gies, in introducing the bio-chemical investigations, says he believes that "the essential factor in the etiology of cancer is a stimulus to cell division of intra-cellular origin, and that complete understanding of the disease awaits more definite determination of the constitution of protoplasm, and the reaction tendencies and functional alignments of the substance peculiar to cells."

"Injury causes different kinds of disease because different discoordinations of intra-cellular constituents result therefrom. . . . Tumours may result from intra-cellular derangements, from discoordinations of functionally related cellular constituents. . . . More closely defined a disturbance in the production of all the anti-bodies directed against the cells or proteins of other individuals of the same species might be of prime importance as an etiological factor in cancer Iso-cells." Unfortunately, Gies's programme could not be carried through owing to the difficulties placed in his way. "Without tumourous animals, without cancer patients, and without carcinomatous supplies, all our plans for direct chemical attack on the cancer problem had to be suspended." All three volumes are well indexed.

Reverting to vol. i, it is correctly described in the sub-title as a review of "The Study of Experimental Cancer," and is a compilation by Dr. W. H. Woglom of all that has been done on experimental cancer. Incomplete reviews are available in Germany by Karl Lewin and in France by Contamin, but there existed up to the appearance of the present volume no complete or, indeed, extensive review of the more recent experimental investigation of cancer. Dr. Woglom has now supplied this want in a most admirable and complete manner. The literature of experimental cancer has grown at a great rate, and is already so enormous that only those who have been in the midst of this work from the beginning can take a comprehensive survey of the subject. To them, however, the book must prove an indispensable book of reference, but it will be even more welcome to others who wish to take up the threads of research now or later. A critical *précis* is not attempted, because so much of the work is too new to permit of fair criticism and evaluation. The results which are likely to prove permanent are set forth in a final chapter.

The volume is written in a remarkably clear style. Contradictory results and deductions are set forth with the utmost effort at impartiality, so that the reader can readily find points of attack for fresh work should that be his object. The indices, both of subjects and of authors, are very full, and the literature given is probably as complete as it can be. It is within the knowledge of the reviewer that Dr. Woglom made especial effort to consult personally all the originals and verify each reference. It is but natural, since Dr. Woglom was for some years a highly-valued assistant of the Imperial Cancer Research Fund, that this fact, and the close association with his colleagues, have led to full recognition of the work of the Imperial Cancer Research Fund; but it was Dr. Woglom's aim that no injustice should thereby be done to any other worker or centre of cancer research.

Vol. i., unlike vols. ii., iii., and iv., has been issued not only as a large quarto, but fortunately in octavo form at the same price. This is really a boon, because by simply cutting off the large margins Dr. Woglom's book has been reduced by more than two pounds dead weight, viz., from more than four to less than two pounds.

It is noteworthy that throughout the three large volumes reviewed, the question of the etiology of cancer is nowhere seriously raised from the viewpoint of a possible "cancer parasite." Cancer is regarded as a problem of growth, and the question of a *stimulus* to growth (a growth hormone in Starling's sense), is frequently and often ably discussed. But in the light of experiment it appears to the reviewer that the question should also be considered from the point of view of the absence or withdrawal of resistance to growth, of "chalones" in Schäfer's sense, if it be justifiable so to extend the term.

E. F. B.

A NEW TACTICAL TREATISE.

The Principles of War. By Major-General E. A. Altham. With an Introduction by General Sir H. L. Smith-Dorrien. Vol. i. Pp. xv+436+maps. (London: Macmillan and Co., Ltd., 1914.) Price 10*s.* net.

GENERAL ALTHAM has produced the first of a series of volumes on major tactics, under the title of "The Principles of War." Although the fundamental principles of war are neither very numerous nor in themselves very abstruse, their application is difficult. War is not an exact science, and cannot be reduced to a series of mathematical formulæ. All that can be done is to deduce from actual experience certain broad principles, and leave it to study and to practice to create an instinct in the mind of the soldier for their correct application to the circumstances of the moment.

But tactics are constantly affected by the progress of science, and disaster may ensue if its effect is not correctly appreciated. In peace there is no means of putting modern appliances to the ultimate test of battle, and imagination must necessarily play so large a part in peace preparation for war, that there is always a danger of fundamental principles being obscured by an exaggeration of the effect of new inventions. Thus General Altham ascribes the French defeats in 1870 to the false theory they had formed that the improvement in the rifle favoured defensive tactics, a theory which ignored the national characteristics of the Frenchman, and committed the French armies to a fatal cult of positions.

General Altham's object in this volume is to illustrate from history the doctrine which the General Staff has laid down for the guidance of the Army, and thus constantly to remind students of the necessity for assigning due importance to the lessons of the past in these days of rapid and far-reaching changes in war material.

Field Service Regulations and the training manuals, which contain this doctrine of the General Staff, while entirely complete in themselves, are necessarily somewhat condensed in form. Field Service Regulations, Part 1, in particular—a 220-page summary of the art of war—every word of which has been carefully weighed, and no single sentence of which could be removed without material loss, may seem to be strong meat to many, and is apt to cause a species of mental indigestion if taken in too large doses. The senior officers of the army will remember, possibly with gratitude, that they were more gently nurtured on the pages of Home and Clery.

General Altham's work bids fair to take the place of these authors on the bookshelves of the younger generation of soldiers. His method is to take a series of texts from Field Service Regulations, and to preach a sound and simple sermon on each of them, impressing his lessons on the mind by one or more graphic illustrations drawn from the campaigns of the last half century. *En passant,* we express the hope that he may be able, both in his subsequent volumes, and in the later editions of this one, to draw more extensively for illustration upon the recent operations in the Balkans.

The book commences with a chapter which should appeal particularly to officers of the British Army, for it discusses those moral qualities which, as a factor of success in war, count for so much more than mere numbers. The bulk of the volume is occupied by ten chapters on the characteristics of the various arms of the service; within these will be found some interesting remarks on mounted infantry, the *rôle* of the cyclist, and the possibilities of aircraft. The remaining chapters deal with such subjects as inter-communication, orders, movements, and billets, all of which will be of particular interest to officers serving, or aspiring to serve on the staff.

But though we are satisfied that General Altham has supplied a much-felt want, we are constrained to sound a note of warning. He expresses the opinion that the study of military history is but imperfectly appreciated by the army at large, and the purpose of his book is doubtless to stimulate officers to read and re-read the campaigns of the great commanders, and that too with greater profit to themselves than in the past. His purpose is wholly commendable. At the same time, we cannot conceal from ourselves the danger, inherent in any volume of this character, that it may be regarded by some as a convenient gold mine of "nuggets" from which to cram for examination purposes, and that, in so far as these officers are concerned, the volumes of military history which are to be found in the well-stocked shelves of every garrison library, may continue to lie there even more neglected than General Altham says they do at present. We trust, however, that our fears on this point may prove to be entirely groundless.

LIFE AMONG THE ESKIMO.

My Life with the Eskimo. By Vilhjalmur Stefánsson. Pp. ix + 538 + plates. (London: Macmillan and Co., Ltd., 1913.) Price 17*s.* net.

THE expedition conducted by Mr. V. Stefánsson and Dr. R. M. Anderson along the shores of the Arctic Ocean is remarkable in the fact that for four years they lived on the country, as the Eskimos do, and trusted little to any stores procurable in Canada, except ammunition. Mr. Stefánsson had prepared himself for this undertaking by a previous journey during which he lived with the Eskimo, supported himself on their food, and learned their language. The result was satisfactory, though even his cheery account of their adventures shows that they were exposed to much danger and privation. Only exceptional travellers can survive under such conditions. John Rae, he remarks, wintered in this manner at Repulse Bay, within a decade of the time when Sir John Franklin's party perished from want in a country occupied by Eskimo, who existed in comparative plenty, unaided by the muskets and other implements which the English possessed in abundance.

The country explored by this expedition extends from Point Barrow in North Alaska, including the valleys of the Yukon and Mackenzie rivers, to Victoria Island, where the most interesting discovery was made. This region was crossed along the seaboard in various directions; large collections of ethnological material, and of the minerals, flora, and fauna were made. These collections are described in a special appendix by Dr. R. M. Anderson, which deals with many interesting and novel specimens. Many of the charts of this region were found to be untrustworthy, and Mr. Stefánsson's surveys furnish a basis for more correct delineation of the coast-line and of the river deltas than was hitherto available. He gives also a useful account of the Eskimo language and its dialects.

The most important part of the book is the account of the comparatively fair tribe of Eskimos encountered in Victoria Island. Some individuals have blue eyes, light brown beards, and dark brown or rusty-red hair. They are clearly distinguished from the true Eskimos by the facial index, which in the latter is about 101, while in the Victoria Island tribe it falls to 97. Mr. Stefánsson discusses in detail the origin of this remarkable tribe. He dismisses the supposition that they can be derived from survivors of the Franklin or other European expeditions, or from Russians in the Alaska region. He traces the Scandinavian settlements in Greenland from the time of Eric the Red at the close of the tenth century of our era. The route from Greenland to Victoria Island occupies a year by boat, two years by sled. There is thus no objection to a westward movement of half-blood Eskimos. On the whole, he seems to regard this solution more probable than the supposition that this blonde type may have been accidentally produced, while the influence of environment cannot account for the facts.

This book will take a high place in the literature of Arctic adventure. It is written in a graphic, modest way, and the tact and endurance of the two explorers deserve hearty recognition. The route map might be improved by the addition of the European to the Eskimo place-names, but the photographs really assist in realising the conditions of the enterprise.

OUR BOOKSHELF.

Interpretations and Forecasts: a Study of Survivals and Tendencies in Contemporary Society. By Victor Branford. Pp. v+411. (London: Duckworth and Co., 1914.) Price 7s. 6d. net.

"THE city," said Aristotle, "exists for the sake of the good life." But only by the good life is the ideal city, the perfect state, to be realised. In other words, social organisation is necessary for individual achievement, but individual achievement reacts creatively upon the social organisation. Mr. Victor Branford, one of the founders of the Sociological Society, has with his spiritual father, Prof. Geddes, done much to illustrate this essential interaction, and still more to infuse a sense of enthusiasm into our appreciation of it. He shows in these lectures the spirit of the medieval guildsmen, who knew themselves to be citizens of no mean city. On their work and ideals he writes a delightful and instructive essay.

The text of the whole book is Aristotle's theory of the city. The author well shows how, as a result of the statecraft of the Renascence and subsequent centuries, a "capital literary fraud" was perpetrated upon that theory. Aristotle saw the city as "a process in which four types of social operation tended to co-adjustment. He saw the Labour of the People, who maintain the outer life of the city; he observed the Public Functions of the citizens, who direct the polity of the city; he perceived the Meditations of Philosophers, who study and compare the polities of cities in order to discover the ideal polity; he recognised the Efforts of Teachers to educate for citizenship. In proportion as all these—the four natural elements of civic life—work together harmoniously, the city comes into being and creates for its citizens the conditions of the good life." The fraud perpetrated upon this theory is the substitution of "state" for "city"; "politician" for "citizen"; "constitution" for "polity"; "political" for "civic"; and "for the science and art of Civics they have substituted Politics." A reaction towards the original and sounder view is to be seen in the decentralising movement of to-day. The author is familiar with the life both of North and South America, and his comparisons of the working of a new spirit in the western republics and in European countries are marked by insight. The place of education in developing the ideal and therefore most efficient relation between man and society, in its most practical because closest and best realisable form, the city, is very fully worked out.

The book is an eloquent example of the practical application of sociological theory.

A. E. CRAWLEY.

The Country Month by Month. By J. A. Owen and Prof. G. S. Boulger. Pp. x+492. (London: Duckworth and Co., 1914.) Price 6s. net.

TWENTY years ago Mrs. Owen, better known, perhaps, by her works under the signature "A Son of the Marshes," prepared, with Prof. Boulger, a series of twelve volumes in which the natural characteristics of the country month by month were described. The series was published in a single volume in 1901, and was given an appreciative notice in these columns (vol. lxv., p. 125). The late Lord Lilford sent the authors a number of valuable notes which were added to the original work, and are also included in the present volume. The new edition has been revised, and is embellished with twelve coloured plates and twenty halftone plates reproduced from photographs. The result is a very attractive book on popular natural history. Many similar books have been published in recent years, but for pleasantly-written description of country life, interesting alike to the general reader and the working naturalist, this volume is among the best. In its present form the book should be acceptable to a wide circle of readers.

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.*]

Migration Routes.

ON November 27, 1913, NATURE published a letter from me in which the suggestion was made that birds when migrating may find it advantageous to follow coast lines or rivers, because of the up-air currents produced by the difference of temperature of the surface of the land and water.

Mr. McLean has recently flown up the Nile, and he tells me that the vertical air currents were frequently very marked. When the wind was only slightly different in direction from the line of the river there was a down current on the side from which the wind came and an up current on the other side. When, however, the river split up into several channels the air was generally descending over the whole neighbourhood and was disturbed. These down currents were at times so strong that his aeroplane when climbing at its greatest speed would descend steadily at 3 ft. per second. He estimates that the maximum rate of climbing of his machine in still air was 4 ft. per second. This observation is of great interest as showing that a down current may exist of about the velocity of 4·8 miles per hour.

HORACE DARWIN.

The Orchard, Cambridge, June 8.

Aeroplane Wings.

IN connection with the apparently growing practice of constructing the wings of aeroplanes so that their inclination can be modified (a scheme which I recommended in the first edition of my book, "The Problem of Flight," published in April, 1907), may I direct attention to my paper read at the Dundee meeting of the British Association in 1912? Therein I referred to the fact that the propeller axis (to which the inclination is, or should be, referred) does not run horizontal so that the propeller thrust has a vertical component. The use of a mechanism by which the wing inclination can be varied enables this vertical component to be annulled, *i.e.* the propeller axis can be kept horizontal, thus greatly increasing the efficiency.

With reference to the question of acceleration in the air and its effect on the reactions, which was discussed some time ago in NATURE in connection with Mr. Walkden's book, a recent paper of mine in *Flight* on oscillating wings may be of interest. It was shown therein that if the reactions during oscillation of the air current vary as the square of the relative velocity, the mean reaction is greater than that due to the mean velocity considered as steady.

HERBERT CHATLEY.

Chinese Government Engineering College, Tangshan, North China, May 24.

Weather Forecasts in England.

MR. MALLOCK, in giving his reasons for believing that correct weather forecasts are not likely to be possible even for twenty-four hours in advance, touches upon many very debatable meteorological theories.

His diagram purporting to show the surface wind currents for an earth, the surface of which is level and uniform, requires for its prediction a much better knowledge of the actual cause of wind distribution than we possess at present. Indeed, at the present time, it would appear that the wind conditions he shows are more nearly those of the northern than the southern hemisphere, and rather are the result of the irregular distribution of land, sea, and mountain than to uniform surface conditions. In the southern hemisphere the conditions, as near the equator, approximate more to belt than to cyclonic conditions.

An inspection of the daily weather charts issued by the Meteorological Office will also show that the general directions of the winds over the northern hemisphere are by no means as Mr. Mallock shows. A cyclone is a much more complex affair than the whirls of his figure. Cyclones are generally rather the result of the common action of several winds moving in different directions. Not only is this the case, but we have no accepted theory as to the cause of cyclones and the source from which they derive their energy.

If it were a simple matter of the passage and rapid appearance and disappearance of cyclones, as Mr. Mallock supposes, I take it that the weather conditions would be rapid alternations of sunshine, cloud, and rain. But such is not the case. We have long periods of fine weather, long periods of wet, unsettled weather, and spells of heat and cold. We must recognise the fact that on the earth we have regions where the weather conditions vary regularly with the seasons, and we also have insular and oceanic weather conditions. The boundaries of these areas are not always the same. The one is apt to encroach upon the other, and it is probable that by obtaining a knowledge of such general movements, weather forecasting for considerable periods of time will be possible.

So long as the old ideas of cyclones and anticyclones held sway, weather predicting really seemed hopeless; but fortunately we find that these old theories, though expressing important truths, require considerable modification in detail. Mr. Mallock's contention that useful forecasting will never be possible seems premature in face of the fact that there are so many things taking place in weather changes the theoretical reasons for which are unknown.

With improved weather charts will come a better knowledge of the theory of cyclones and anticyclones. However, it may never be possible to predict, from the to-be-discovered laws of the winds, the course of weather changes with the certainty the movements of the members of the planetary system can be predicted by the application of Newton's laws.

R. M. DEELEY.

Abbeyfield, Salisbury Avenue, Harpenden.

The Thunderstorm of June 14, at Dulwich.

MY observations on the thunderstorm of Sunday, June 14, at Dulwich, may perhaps be of interest.

Thunder was first heard a little before 12.30 p.m., and lightning was seen from about 12.45. These continued more or less throughout the afternoon until quite 5 o'clock, the lightning being very brilliant and rather frequent. Heavy rain fell from 12.50 until 1.10, and from 1.15 to about 2.20. Some white hail fell about 1.45.

At 2 p.m. there was a heavy fall of big hailstones as large as marbles, which lasted about five minutes. Many of these hailstones were like large acid tablets, about an inch long, half an inch broad, and more than a quarter of an inch thick. The hailstones were composed of perfectly clear ice, and did not contain any white opaque substance. Hailstorms are usually accompanied by gusts or squalls of wind; in this storm, however, there was but little wind.

When the big hailstones fell the leaves were torn off the trees, and so the pavements immediately beneath them became quite green with the fallen leaves. The heavy rain, however, quickly washed these away, so that they were carried into the gutters and soon stopped up the drains, with the result that the roads were flooded.

A minute or two after the big hailstones had fallen, a mist arose above the roads and pavements to a height of about 4 ft. This clearly showed how the fogs were formed near the Banks of Newfoundland owing to the mixing of the cold and warm sea current.

Rain came on again about 3.15, and continued until 4 p.m.

It was not able to get to my rain-gauge in Alleyn Park until after 5 o'clock, as the lawn was flooded and the water had not subsided sufficiently for me to get into the garden. I found the rainfall to be 2·15 in., and of this amount I believe that about 1·60 to 1·75 in. must have fallen in three-quarters of an hour, from 1.30 p.m. to 2.15 p.m.

WM. MARRIOTT.

Royal Meteorological Society, 70 Victoria Street, London, S.W., June 16.

A Dual Phenomenon with X-Radiation.

SINCE our paper on the "X-Rays and Concentration," and our exhibition of models and negatives at the annual general meeting of the Röntgen Society on June 9, we have obtained further results which favour the hypotheses then suggested.

For instance, if a radiograph be taken at any incidence (except 0° and 90°) of a ring of rectangular cross-section made in ebonite, its circular edges will be distinctly visible as black and white *semi-circles*. These alternate for the top and bottom outer rings, and they are in the reverse order for the inner circles. These differences were predicted from the generalisation we gave in the paper. We think it would be advantageous to repeat the conclusion of the paper for those who were not present at the exhibition:—

"Generalising our results, it would seem that when X-rays are incident (or emergent) simultaneously upon two surfaces having a common boundary, this will be marked by a white or black band according as the dihedral angle of the solid is greater or less than 180°. If, however, the rays are incident upon one of the surfaces only, and emergent from the other, the order is reversed. In the third case, where the rays are incident upon one surface but parallel to the other (as with single laminæ) the two bands appear in close association, and are observable with difficulty without the aid of suitable magnification." Tangential radiation has given a black or white band according as the surface was convex or concave.

J. G. RANKIN.
W. F. D. CHAMBERS.

90 Gordon Road, Ealing.

LEGISLATION AND THE MILK SUPPLY.

MILK legislation, as represented by the Milk and Dairies Bills of 1909 and 1912, has so far been characterised by a want of definiteness which has probably been the cause of much of the opposition which it has aroused. This opposition has come about both from the peculiar character of the requirements laid upon the medical officer of health in connection with the inspection, etc., of dairies and cowsheds, and also from the trade itself, on account of the omission of any practical attempt in the earlier Bill to deal with some of the evils which everyone desires to see put right, and from a feeling of uncertainty as to what might happen under the rather extensive powers which that Bill gave to public health authorities. For these reasons the President of the Local Government Board found himself assailed both by the medical officer of health and by representatives of the trade, with the result that in both cases the Bill was eventually dropped. Many of the controversial features of the earlier Bill to which attention was directed were rectified, to a certain extent, in the Bill of 1912, but the powers, etc., of the medical officer of health were not made particularly clearer, and there was still no definite assurance that reforms would be carried out in a satisfactory manner. The chief objection which was raised to both these Bills was that with regard to the principal evils for the rectification of which legislation is so greatly needed, amendment was left in the hands of the Local Government Board by the issue of regulations *after* the passage of the Bill, and apparently without consultation with anybody.

The problem of drafting a satisfactory Bill is likely to be more difficult than previously, for the conditions of milk supply have changed considerably during the last five years, and the attitude of the farmer must be considered for the successful issue of any milk legislation. It is probably a necessary concomitant of all legislation that it should largely deal with pains and penalties towards those who do not carry out its requirements, but legislation ignores the fact that those so threatened may clear themselves from the fear of such penalties by ceasing to come under the legislation in question, and this is exactly the situation which it is necessary to realise has arisen of late in the milk trade. The farmer, at the present time, is probably rather independent as to whether he produces milk or not. In any case, a large quantity of milk is being produced for purposes other than ordinary milk supply, and these diversions of milk are becoming greater, and it may not be necessary that the same care should be taken with regard to milk which is used for such purposes, as would be the case if the milk were directly used as food material.

To those who are accustomed to deal with farmers on a business basis, it is evident that any attempt to carry out drastic or theoretical alterations in connection with the production of milk would simply result in intense opposition, and a great increase in price for the article supplied. There is at the present time almost a trades unionism among farmers, by means of which the wholesale price of milk, for no justifiable reason, has been gradually increasing during the last three or four years, and as there appears to be no power which may be invoked which will prevent the farmer increasing his price indefinitely, he would be only too pleased to have some really sound reason to bolster up his present attitude. For this reason the provisions in the earlier Bills which make it incumbent upon the medical officer of health and the sanitary authorities to carry out farm inspection is probably a mistake. The medical officer of health, as a rule, will have little knowledge of farms, cows, and their surroundings, and there usually will be a lack of sympathy between him and the farmer. One looks upon the other as an ignoramus, and the latter regards the former as a theoretical person who knows nothing about the farmer's business. Though the production of a new type of official is to be deprecated, if a special course in sanitary science were added to the ordinary veterinary course, on lines similar to the post-graduate courses which enable a medical man to obtain the diploma in public health, there is no reason why the younger generation of veterinary surgeons should not become amply qualified to carry out farm inspection, while their training would gain for them the respect and sympathy of the farmer.

It is quite certain that much of the present condition of milk production in the country arises more from ignorance than from deliberate intention, and certainly for a year or two after the introduction of any legislation dealing with the production of milk, it would be desirable to proceed with caution, and on the lines of advice and help, rather than upon those of compulsion. Among the younger generation of farmers there are many who will be better able to appreciate the requirements of modern milk production than their forefathers; but as they will probably inherit the typical British obstinacy of the farmer, it would be necessary that they should be led rather than driven.

It must not be forgotten also that the question of improvement of milk production, particularly as regards premises, water supply, etc., is much complicated by the attitude of the owners of the farms, who may be disposed to get rid of farmers from their premises rather than to carry out any very considerable improvements which might be required of them in connection with milk production for food.

It is important in any Bill that the prohibition of the addition of colouring matter and preservatives of any kind should be made, as well as of the addition of skimmed milk to ordinary milk; and with this last might be coupled a further regulation that notices to the effect that such admixture is illegal should be posted in all dairies, in order that employees as well as employers should fully understand that such a regulation is in force. At the present time, a large amount of skimmed milk is added to ordinary milk, and such a practice is likely to continue if the present wholesale price of milk holds. Such admixture makes it exceedingly difficult for the honourable trader to compete with his less scrupulous rivals. It would also be well if some regulation were introduced dealing with the question of pasteurisation, and it should be made compulsory that all milk which is pasteurised for sale and constitutes more than, say, 25 per cent. of the total quantity of mixed milk sold, should be labelled "pasteurised," or the knowledge that it has been pasteurised in some way conveyed to the consumer. There is no doubt that the practice of pasteurisation is spreading on account of the more independent and careless attitude of the farmer.

It should also be possible for distributors receiving milk from farmers to ask the public authorities to take samples of any farmer's milk, which for any reason is believed to be adulterated, at the stations on arrival, and for such samples to be analysed, and the proceedings taken against the farmer when necessary, without in any way the name of the distributor being brought into the question, as the present conditions of milk supply have brought about a position such that the farmer may, if troubled too much by any particular distributor, refuse, on a future occasion, to supply milk to him, and may also very probably notify farmers in the neighbourhood that such and such a buyer is an exacting person or concern, with the result that those distributors who are endeavouring to preserve a high standard may become boycotted.

There appears to be at the present moment a favourable attitude towards the idea of grading milk. However well this may work in America, the result of selling milks of different grades in England will be that milk will deteriorate to the lowest grade, with the exception of quite a small quantity which a few people who wish for milk of a better quality will take. There is plenty of evidence at the present time that the general public buys milk simply on a basis of its price, and without any regard to its quality or source, and it would be most unfortunate if the sale of a low-grade milk were possible. History would repeat itself in this as it has in the case of water in butter, which, since it was made legal to sell 16 per cent. of water in butter, has gradually risen to this limit, though previously the greater number of high-class butters had a considerably smaller percentage of water than 16 per cent. The ordinary householder does not want to be bothered to consider what grade of milk he ought to purchase; he desires to obtain milk which is a reasonably sound commodity which he can consume, without cause for serious apprehension, in the raw state in which he generally prefers it.

A further, and what may prove a serious, obstacle to the improvement of the milk supply looming in the near future, results from the fact that a trades union of milk carriers has recently been formed. One of the principal planks in their platform is that there should be only one delivery on Sundays, which, though quite a laudable idea in itself, would inevitably lead to great deterioration in the bacteriological quality of the milk supplied on Mondays; and from the general attitude of the labour mind, if this point were achieved, it would doubtless occur to them that one delivery every day might also be sufficient, with disastrous results so far as the ordinary milk supply is concerned.

It is one thing to legislate and quite another thing to put such legislation into operation when there are such determined labour forces opposing progress. There is no more regrettable feature of the labour world to-day than the steady decay of high principle and honesty of purpose which is making it all but impossible to carry out satisfactorily such rules and regulations as are so necessary in the handling of milk. It is necessary to sue as a favour for that which ought, with right-minded men, to be expected or demanded as a right. This careless attitude, combined with an ignorance of the elementary rules of cleanliness, render the handling of milk a source of constant and harassing worry to the managers of large dairies.

There is also a great lack of cohesion among milk dealers themselves which makes any combined effort for good very difficult of accomplishment, and it must be said with regret that there is also a lack of a right and high ideal in many quarters.

Reverting to the question of legislation, it is desirable that measures should be taken to put a stop to the type of dairyman who carries on his business surreptitiously, who emerges from obscurity when there seems a chance of making some profit at the expense of the legitimate trader, peddles a liquid which has a quite uncertain relation to the cow (and would never be bought by anyone if it were not sold cheaply), and retires again into obscurity when it becomes unprofitable to continue.

With regard to regulations concerning the procedure to be observed in the milking, etc., of cows, the greatest simplicity is essential if there is to be a chance of such procedure being carried out in any real sense, as the times and seasons at which milking has to be done are not conducive to the development of any great enthusiasm with regard to care on the part of the milker. It is hard enough to obtain milkers at the moment, and any great addition to the labour of milking might easily result in a very real dearth of such men. This is, again, a case for careful and patient education rather than for the thunders of legislative pains and penalties.

No Milk Bill has yet shown the least attempt to bring the railway companies into a proper state of mind as to the necessary care and expedition in the carriage of milk.

Since the above was written a new Bill has been introduced into the House of Commons by Mr. Herbert Samuel. Its principal clauses, like its predecessors, are those requiring regulations to be made by the central authority with regard to the inspection of cows, cowsheds, and milk shops, the prevention of infection and contamination of milk, the mixing of milk with separated milk or other substances, and conditions of storage and transit. These regulations apparently are to be enforced by a new set of authorities—the county councils instead of the district councils—which is a step in the right direction, and by means of a staff which, in addition to the medical officers of health, is to include veterinary officers and bacteriologists. A sound principle is likewise adopted by making each authority responsible for the milk produced in its own area, and also by enabling the authorities in the town to requisition action by the authorities in the country as a result of bacteriological or other sufficient evidence against the milk. A clause in the Bill introduces a drastic change in the practice of dealing with adulterated milk. Milk is now to be regarded as genuine, however low the percentage of fat, provided it can be proved that it has not been tampered with after leaving the cow. Though not perfect, the present Bill is undoubtedly an improvement on its predecessors, but there seems little prospect of its passing during the present session of Parliament.

R. T. HEWLETT.

THE COMMEMORATION OF ROGER BACON AT OXFORD.

THAT the year 1214 saw the birth of Roger Bacon is rather a matter of probable inference than of certainty. There is, however, good evidence that he died in 1292, and was buried on St. Barnabas' Day (June 11) in the precincts of the Grey Friars at Oxford, a quarter of the city which is now known as Paradise Square. Hence there was sufficient reason for the celebration at Oxford on June 10 of what was called the "seventh centenary" of the great Franciscan, and for the gathering together of representatives from many parts to do honour to the memory of one who, as the unflinching advocate of experimental science as against authority, was held by Humboldt to be "the most important phenomenon of the Middle Ages."

No record appears to exist of the characteristics of Bacon in form and feature. In the statue, however, which was unveiled at the University Museum on June 10, Mr. Hope Pinker has contrived to give the impression of alertness, shrewdness, and pugnacity—qualities which his subject most certainly possessed in full measure. The face also carries a suggestion of humorous depreciation, which sits not inappropriately on the effigy of the man who professed to be able to teach anyone to read Greek in three days, and who would fain have burned all the then existing translations of Aristotle. But whether the sculptor has or has not succeeded in reconstructing the bodily aspect of the real Roger, a point which can never be decided, there is no doubt as to the accuracy of his presentment of the Franciscan garb, or of the astrolabe held in the strenuous grasp of the friar.

In his speech preparatory to the unveiling, Sir Archibald Geikie laid due stress on the greatness of Roger Bacon as a pioneer of the experimental method in science. "Dispensing with the futile disputational subtleties of the schoolmen of his day, he strove to concentrate attention on things rather than words. He led the way towards the conception of science as the inductive study of nature, based on and tested by experiment." A similar note was struck by Lord Curzon, who in his capacity of Chancellor accepted the statue on behalf of the University of Oxford. After recounting the various branches of learning which Bacon had studied and on which he had written, a list which includes not only nearly all that we understand by physical science, but also moral and political philosophy, the Chancellor went on to

Roger Bacon Statue in the University Museum, Oxford.

point out that in these sciences Bacon was not a mere amateur. "He did not dabble with them, so to speak, in holiday hours, but studied them profoundly." Moreover, he wrote with intense conviction about their essential interdependence one on the other.

Following the ceremony of unveiling, an address was delivered by the Public Orator of the University, Mr. A. D. Godley, of Magdalen College. In elegant Latin periods the orator paid tribute to the diligence and fearlessness which had enabled Roger Bacon to accomplish a great work in the face of difficulties. Turning towards the statue, he exclaimed:—

Welcome, Friar Roger, on your return to Oxford! You here behold the fruit of your labours. . . . Henceforth may your bodily likeness stand in that shrine of science where we witness the fulfilment of your prayers and wishes. May the spirit that inspired you abide with us everywhere and always: may it preserve our understanding from the bonds of error, and by its presence strengthen and confirm us in the pursuit of the truths of nature.

The ceremony at the museum concluded with the presentation of addresses from the University of Cambridge and from the Franciscan Order of Friars Minor, the former by Prof. James Ward, the latter by Fr. David Fleming.

At a luncheon which was given by Merton College, the Warden presiding, the memory of Roger Bacon was proposed by the Bodleian Librarian (Mr. F. Madan), who took occasion to mention the west-country origin of the subject of the toast, and the encouragement which he received from Pope Clement IV. This was supported in an eloquent speech by M. F. Picavet, representing the University of Paris. The other delegates were welcomed by the Chancellor, and replied to the toast of their health in speeches of great interest. The delegate of the Vatican Library, Monsignor Ratti, speaking in Latin, announced the recent discovery of a new Baconian manuscript. The Comte d'Haussonville and M. Henneguy, both members of the French Academy, answered respectively on behalf of the Institut and of the Collège de France. Fr. David Fleming spoke for the Franciscan Order, and Prof. James Ward for the University of Cambridge. Sir W. Osler conveyed the thanks of the company to the Warden and Fellows of Merton College.

Many of the visitors attended the Romanes lecture on "The Atomic Theory," given by Sir J. J. Thomson. Others proceeded to the Bodleian, where the librarian had arranged an exhibition of Baconian books, prints, and manuscripts. This comprised MSS. of the Opus Majus, the Opus Tertium, and fragments of the Opus Minus, together with many other MSS. of interest, including the curious treatise "de retardandis senectutis accidentibus." The volume of memorial essays lately published under the editorship of Mr. A. G. Little was also on view.

The events of the commemoration ended with a party in the garden of the Warden of Wadham College. F. A. D.

ADDRESS TO THE UNIVERSITY OF OXFORD.

The following is the address written by the Public Orator of the University of Cambridge, and presented by Dr. James Ward at the celebration:—

Gratulamur Universitati vestrae, viri litterarum et scientiarum omnium amore nobis coniunctissimi, quod annum septingentesimum ex quo natum est scientiarum et litterarum lumen illud vestrum, Rogerus Bacon, mense proximo vosmet ipsi, cum aliis quibus alumni vestri memoria cara est, celebrare constituistis.

Viri tanti fama ad posteros quam tarde pervenerit, non ignotum. Scilicet anni intercesserant trecenti, cum libellus de mirabili potestate artis et naturae ab eo conscriptus, typis expressus est; quadringenti sexaginta sex, cum eiusdem Opus Maius publici iuris factum est; prope sescenti denique, cum Opus Minus et Opus Tertium diei lucem primum viderunt. Opera autem eius tam multa tamque late dispersa fuisse perhibentur, "ut facilius sit Sibyllae folia colligere," e quibus nonnulla, vixdum nota, vosmet ipsi, cum aliis coniuncti, in lucem mittere decrevistis. Atqui, etiam in libris eius, quos iamdudum habemus, luce clarius est, quanto litterarum Graecarum, Hebraicarum, Arabicarum, quanto scientiarum omnium amore flagraverit, qui, quanquam scientiae uni potissimum investigandae annos decem dedicavit, ceteras nequaquam neglexit, scientias omnes inter se connexas esse, et mutuis sese fovere auxiliis, non immerito arbitratus.

Idem quam multa, quae nostra demum invenit aetas, mente sagaci prospexit, Senecae sui verbis illis praeclaris usus:—"veniet tempus quo ista quae nunc latent, in lucem dies extrahat et longioris aevi diligentia." Vaticinium etiam alterum nunc demum auspiciis vestris verum redditum est. Etenim, abhinc annos plus quam trecentos, poëta quidam Cantabrigiensis praedixit, fore aliquando, ut Anglia et Europa Baconis vestri famam admirarentur, atque ut Oxonia praesertim alumnum suum statuarum honore in perpetuum celebraret. Ergo etiam posteros iuvabit Historiae Naturalis in Museo vestro iuxta Baconis nostri imaginem etiam Baconis vestri statuam non sine reverentia contemplari.

Has litteras benevolentiam et observantiam nostram testantes legato maxime idoneo, philosophiae e Professoribus nostris altero, ad vos perferendas tradimus. Valete.

THE COMMITTEE ON WIRELESS TELEGRAPHY RESEARCH.

THE appointment of the committee on wireless telegraphy research, and its report, referred to in last week's issue of NATURE (p. 385), are indications that the somewhat fierce light that the Marconi inquiry brought to bear upon the unscientific methods of the Post Office is at length having some effect. No longer is it possible that a high Post Office official should annotate a memorandum, prepared by a very responsible technical officer, recommending the appointment of some engineers destined to form a skilled wireless staff, with a paragraph to the effect that "common-or-garden" engineers are good enough for wireless telegraphy. To the Marconi committee, however, Sir Alexander King, secretary of the Post Office, admitted that the office could not undertake the design and erection of the imperial wireless stations for the reason that they had in their employment no one with the necessary knowledge and experience, surely a very humiliating position for the State department which controls the whole of the national telegraphs, with a large technical staff, and spends thereon huge sums of public money.

Since then it is satisfactory to note some change in the official mind, first in the appointment, some months ago, of Mr. Duddell to assist the telegraph department with technical advice, and secondly in the appointment of the very representative committee of which the report is now under review.

The report now published is in favour of establishing, near to the National Physical Laboratory at Bushey, a special national research laboratory where work on wireless telegraph problems will be carried on, while investigations in connection with ordinary telegraphy and telephony will not be excluded. The laboratory is to be controlled by a national research committee consisting partly of representatives of the Post Office, Admiralty, War Office, and Treasury, and partly of paid members nominated for short terms of years by the Royal Society and the Institution of Electrical Engineers, together with the director of the National Physical Laboratory.

As the capital cost of the laboratory is estimated at only 7,300*l.*, and the total annual expense, both of laboratory and committee, at only 4,800*l.*, sums which are very small in comparison with the possible savings that such a research laboratory ought to be able to assist in effecting in the vast annual expenditure on the national telegraph service, the proposals cannot be considered in any way extravagant. Indeed, if anything, they appear to err on the side of insufficiency. For instance, the secretary of the proposed research committee, who, in addition to possessing the usual qualifications for such a post, including a knowledge of French and German, is to be a man of technical training and experience, is only to divide 300*l.* per annum between himself and a clerk. Again, the principal assistant, who must obviously be a first-class technician, as he is to have complete charge of the laboratory under the director of the National Physical Laboratory, is only to get a salary of 400*l.*

Further, it is suggested that the honorarium given to each of the paid members of the proposed committee for their attendance at meetings is to be fixed at ten guineas a meeting, it being proposed that during the first two years there will probably be fifteen meetings per annum, and after the first two years ten meetings. No doubt eminent men of science will be found ready to give their time to the State at this rate of remuneration, as equally would they no doubt be found to do so for nothing; but it may be pointed out that this amount of pay suggested for the committee, presumably for men of the highest scientific capacity and experience, is only about one-half what the average company director, who may have no special experience or training, commonly obtains for attending the board meetings of medium-sized companies in the City of London. The fact that Sir Alexander King, the secretary of the Post Office, and Mr. R. Wilkins, of the Treasury, are of opinion that the payments suggested are on too liberal a scale, is significant evidence of the low value that non-technical Government officials attach to scientific attainments.

However, the recommendations contained in the report, if adopted by the Government, will be a beginning in the right direction, and it is satisfactory to know that similar arrangements in connection with the advisory committee for aeronautics, established in 1909, of which the research work is carried out in the National Physical Laboratory, are working well. It will always be open to the research committee, when once it is established and has had time to prove the value of its work, to point out that with ampler resources it could do more.

A. A. Campbell Swinton.

THE URGENT NEED FOR ANTHROPOLOGICAL INVESTIGATION.[1]

The Carnegie Institution of Washington has taken the wise step of inviting certain experts to report on the special needs of anthropological investigation, and have printed the reports of Dr. W. H. R. Rivers, F.R.S., Prof. A. E. Jenks, and Mr. S. G. Morley in a sumptuous *brochure*.

Dr. Rivers lays particular stress on the special urgency of the needs of anthropology, due to the character of its material, this factor of urgency being wholly or almost without importance in other branches of science. Only exceptionally can the investigation of archæological problems be regarded as urgent, and he believes that science will gain in the long run by delaying archæological exploration. He contrasts with this the case for ethnology, and adds, "In many parts of the world the death of every old man brings with it the loss of knowledge never to be replaced." He contrasts "survey work" with "intensive work," and proves the importance of the latter. The most favourable moment for ethnographical work among any given people is discussed, and the different kinds of agencies by which ethnographical work is now being carried out, his remarks on investigations by officials and missionaries being both just and sympathetic.

Preliminary training in scientific methods is essential, and Dr. Rivers agrees with Friederici that investigators working alone seem to obtain more valuable results than expeditions comprising a whole staff of experts. "The work of an expedition will attain its highest efficiency if it seeks to combine the advantages of individual enterprise with the work of specialists where this seems indispensable." Collecting expeditions for the enriching of museums rarely accumulate any intimate knowledge of the natives that is of much value; indeed their tendency is unconsciously in the opposite direction. Everything which the intensive worker obtains will have an infinitely wider and deeper meaning than anything which can be obtained by the cursory visitor, and the processes of manufacture can be collected, which are even more important than the finished article.

Physical anthropology can be postponed till a later stage of the inquiry. It follows that the prime need of anthropology is for the intensive investigation of those living examples of human culture which are most likely to disappear or suffer serious decay. Dr. Rivers then makes a brief survey of different regions of the globe outside America, with the object of ascertaining the urgency of the needs, and how far these needs are being met by existing agencies. "Perhaps the most urgent needs for Europe are for the study of the existing cultures of Lapland in the north, and of the countries of its south-eastern corner, and especially of Albania." The pressing need for research in South Africa "stands beyond all question." The ethnological problems of Asia, except

[1] Reports upon the Present Condition and Future Needs of the Science of Anthropology. Presented by W. H. R. Rivers, A. E. Jenks, and S. G. Morley. Pp. 91+14 plates. (Washington, D.C.: Carnegie Institution of Washington, 1914.)

perhaps in a few places, are regarded as presenting no special urgency. The same applies on the whole to Malaysia, where very little intensive work has been done as yet. Parts of New Guinea and the larger islands of Melanesia can well be left for the present, others require immediate investigation, as do all the smaller islands. "There is probably no part of the world where a larger amount of valuable material can be saved during the next few years than in Melanesia, and yet at the present moment little or nothing is being done." Much work and this of great urgency remains to be accomplished in Australia. "A thorough survey of Polynesia will yet provide material of the utmost value to the ethnologist." "In Micronesia the conditions are more satisfactory . . . but there still remain . . . islands, such as the Gilbert and Ellice Groups, about which our existing knowledge is trivial." He concludes by saying:

"Two regions, southern Africa and Oceania, combine an extreme degree of the urgency of their needs with very inadequate attempts to meet those needs. Of these regions it is suggested that Oceania should have the preference. It includes places where interesting and important examples of human culture are on the verge of extinction and other places which are in a condition especially suited for intensive work, so that a large mass of valuable material can be obtained with relative ease. Through its insular character Oceania presents conditions of especial importance in the study of certain theoretical problems, and it has a special interest in that its culture stands in close relation to that of the American continents. It is suggested that the study of a region allied in culture to that of America may react on the study of American ethnology, and may prove the best means of reaching positive conclusions concerning the exact nature of the indigenous culture of America."

Prof. Jenks gives a brief account of the subject-matter and present status of anthropology. In a section entitled "Research problems and opportunities in Anthropology," he deals solely with the Indo-Pacific and American areas. For the former he takes as his main theme the problem of the origin and spread of the Pacific islanders and their culture, and remarks that "Churchill recently has largely solved the Polynesia migration problem in the Pacific Ocean." He suggests that in Polynesia "a true knowledge of the genesis of the speech of man" possibly may be discovered, and quotes from Churchill that the Polynesian languages are of "the most elemental character," and the "parts of speech have but just begun to make their appearance." Churchill even says positively that "we find ourselves engaged with a language family in which we can discover the beginnings of human speech." These statements are very remarkable if it be true, as other linguists assert, that the Melanesian variants of the Austronesian languages exhibit more primitive features than the Polynesian (Codrington definitely states that the Polynesian group of languages is "late, simplified, and decayed" as compared with the Melanesian), and if we are to look for the "primeval home" of the Polynesians in the Ganges Valley. One would like to have the evidence for Churchill's statement that "the Tongafiti migration has left absolutely no trace of its passage in Melanesia." Prof. Jenks refers to certain problems, such as the decay and loss of culture forms, and to prehistoric stone remains, and he recommends further excavations at Trinil for *Pithecanthropus erectus*, and a study of the individual and communal life of the orang-utan.

The antiquity and origin of man in America, and the origin and spread of aboriginal American culture are put forward as special questions requiring to be decided. The solution of the problem of the "extra-American origin of culture . . . would contribute not only to the present subject, but to the anthropological world-problem of culture similarities—whether similar cultural expressions in isolated areas had a common origin, or independent origins, or are due to transmission." Three of the most important modern anthropological problems of the Western hemisphere and the Pacific islands, of which Prof. Jenks advocates the study, are ethnic heredity, influence of environment on mankind, and human amalgamation, and he proposes that a permanent laboratory should be established eventually in connection with these studies.

Mr. Sylvanus G. Morley makes a strong appeal in his beautifully illustrated essay for a prolonged and thorough investigation of the great group of ruins at Chichen Itza in northern Yucatan. It is his belief "that no other archæological field in the New World offers such rich promise as the region occupied by the ancient Maya, and, at the same time, no equally important field has been so inadequately studied."

The facts and arguments adduced by Dr. Rivers and Prof. Jenks point clearly to Oceania as being probably that part of the world which most urgently needs ethnographical investigation, and if the Carnegie Institution could see its way to organise a commission for the intensive study of as many portions of that area as possible, combined with an investigation of the more general problems of racial and cultural movements, it would confer an incalculable boon on all present and future students of the history of human culture. If this be not attempted very soon the opportunity will pass away for ever.

A. C. HADDON.

THE PRINCIPLE OF RELATIVITY.[1]

II.

AT the root of what are generally thought of as our intuitive notions of space and time lies the conception of simultaneous instants at different points. The sensations by which we actually perceive bodies are, strictly speaking, not distributed through space; but the mental picture which we construct of the phenomena is ordered under the categories of time and space, and in

[1] Continued from p. 379.

this way of ordering the idea of simultaneous events at different places is essential.

Now the very first thing that appears, if we accept the hypothesis of relativity, is that it is impossible for us to determine uniquely whether two events are or are not simultaneous. This can be best illustrated by a simple ideal experiment. Retaining for the present the conception of a unique stationary æther, let us suppose that two points A, B, are moving relative to it with the same velocity v, and let c be the velocity of light. Now imagine a ray of light to be sent out from A at an instant t_1, in the direction A B. Let this ray arrive at B at the instant t_2. Let it then be reflected back to A, arriving there at the instant t_3. Now if the distance A B is l, since the relative velocity of the light on the outward journey is $(c-v)$, we have

$$t_2 - t_1 = l/(c-v),$$

and similarly since the relative velocity on the return is $(c+v)$,

$$t_3 - t_2 = l/(c+v).$$

From these equations we obtain

$$t_2 = t_1 + t_3/2 + lv/(c^2 - v^2).$$

Now if the velocity v were zero, we should have the result that the moment of reflection at B is simultaneous with the moment $\frac{1}{2}(t_1 + t_3)$, that is, with the moment at A midway between those of emission and return of the ray. But if the velocity v is unknown, which is the hypothesis with which we are dealing, then we cannot say from this experiment what instant at A is simultaneous with the instant t_2 at B.

Now no man of science should say, of course, that because he does not know, or cannot determine a thing, that, therefore, it does not exist. We have no right to say that, because we cannot determine our velocity relative to the æther that therefore the æther *cannot* exist. So we do not say that the conception of "simultaneity" is an absurdity; what we do say is that the notion is not an intuitive one, forced upon us with a unique significance apart from all material phenomena; but that it is a convenient element in our ways of thinking about phenomena, and is really inseparable from the whole body of thought about them, that is, from the laws by which we conveniently describe their sequences.

In the light of the simple experiment described above, therefore, we find that the conception of "simultaneity" does not become definite until we have assigned a definite velocity to a certain point, which may conveniently be our own point of observation.

The next thing we may notice is that the notion of the "length of a body" becomes indefinite along with the term "simultaneous." For in our usual ways of thinking, the length of a body is the same as, is in fact defined to be, the distance between two points of our universal frame of reference, with which the ends of the body "simultaneously coincide." Until we have made the last phrase definite, the length of a body is either indefinite, or else it must be defined in some other way, in which case we might have a contradiction between the definition of length and the derived concept of measurable space.

In the light of these difficulties we may be prepared to reconsider our preconceived notions of the measures of space and time and what is implied in respect of them by the laws which we find to be the best expression of the order which we have disentangled from the complex of physical phenomena, including among those laws the principle of relativity.

As was stated at the beginning, this includes the statement that it is impossible for an observer to detect a difference between the velocities of light in different directions, whatever may be his own motion. In other words, the propagation of light through space is supposed to be expressible as a uniform propagation in all directions with velocity c whatever velocity the observer supposes himself to have. This is a self-contradictory assumption if we adhere to the space and time which we use in Newtonian dynamics, where the relative velocity of two points is just their difference. But if we grant that our measures of space and time are, as has been suggested above, modes of thought inseparable from the laws into which they enter, then we realise that what we have been in the habit of looking upon as assured and permanent elements in our thought may, with the development of our knowledge of the physical world, come to require modification.

If now we start from the fundamental law that there is a definite physically-determined velocity, that of light, an invariant element in the physical world, we can proceed by an algebraic process to examine what variety is possible in the quantities by which we measure space and time. This is a problem capable of complete solution, and when it is carried out we find that there is a large degree of arbitrariness. It appears that out of all the possible systems of measurement so obtained we can always find one such that all points at rest in this system have an arbitrary uniform velocity in any other given system. If this velocity is v and if two simultaneous events as estimated in the time variable of the first system occur at two points at distance l apart on a line parallel to v, then as estimated in the second space-time system, they occur at instants separated by a time $lv/c(c^2 - v^2)^{\frac{1}{2}}$, at points the distance apart of which is $cl/(c^2 - v^2)^{\frac{1}{2}}$.

The remarkable thing is that when we have developed this infinite number of ways of measuring space and time out of the single hypothesis of the universal value of the velocity of light, we are able to show further that the whole set of laws of the electromagnetic field may be retained in the same form whichever of the systems of measurement we adopt. Thus we find that not only space and time, but the physical quantities, electric and magnetic intensity, and the force on a charged body, are quantities which are "relative," that is, which are only uniquely defined after the choice of the system of reference has been made; that is, after we have stated in advance what velocity we assign to some one particular point of the moving bodies.

It appears too that the acceleration of a moving point has a relative magnitude, and so we find that the ratio of the force on a small charged body to the acceleration produced in it, is also a quantity which depends on the particular frame of reference used; the directions of the force and the acceleration cannot even be taken to be the same in all systems of measurement; that is, the acceptance of our fundamental hypothesis makes it impossible to maintain the Newtonian conception of "constant mass." The modifications required in the dynamical laws are, however, borne out by the results of the well-known experiments on the variable inertia of the negative electrons which constitute the kathode rays and the β rays, particles the velocities of which are so great that the deviation from the ordinary laws are considerable.

A more important question even than that of the mass of the electron is that as to whether this modification in dynamical laws is allowable in the light of the enormous mass of support which the older theory receives from its agreement with the facts of planetary motion. All that can be said here is that with the modified conception of mass, and a modification of the law of gravitation which attributes to it the velocity of light and a deviation from the inverse square rule of such a kind as to make it consistent with the relativity of forces, de Sitter has shown that there is complete accord between existing observations and the demands of the hypothesis of relativity.

The Aether.

It was emphasised above that the stationary æther as it is commonly conceived is in reality nothing more than a mathematical frame of reference. Now we have seen that this frame of reference is not unique. Does the æther, therefore, not exist? We can certainly say that, if it exists, it is not to be identified with the frame of reference. What we want is to be able to reconcile the idea of a unique medium, which is the mechanism by which electrical effects are transmitted, with the mathematical equations which do not determine a unique frame of reference. This cannot be done except by attaching some concrete significance to the electrical magnitudes in terms of the constitution, motion, or distortion of this medium. As we at present know them, the terms "electric intensity," "magnetic force," "motion of the æther," have only a relative significance. If we contemplate an objective æther it might be possible to construct out of relative quantities depending on the motion of the æther a quantity which would have exactly the same kind of relativity as the electric intensity for example; that is, the electric intensity might be put into unique definition in terms of the æther, though both are only expressed relatively in terms of the frame of reference.

The principle of relativity then does not deny the existence of an æthereal medium; that is only the interpretation of an individual. What it does do is to emphasise the insufficiency of the existing conceptions of the æther, and to set up a criterion by means of which suggestions as to the nature of the æther may be examined.

E. Cunningham.

PROF. HUGO KRONECKER, FOR.MEM.R.S.

On Saturday, June 6, Hugo Kronecker, one of the first rank of living physiologists, died suddenly of apoplexy. Although he was seventy-five years of age, his intellect was as keen, his energy as great, and his unselfishness as unbounded as at any time in his life. This is saying much, for these characters had been his in no ordinary measure. His life's work consisted chiefly of investigations into the contractility of muscle, the movements of the heart, and the effect upon it of rarefied air. He discovered almost simultaneously with Marey the curious fact that during one period of its cycle the ventricle will not respond to stimuli. To this time Marey gave the name of refractory period. He found also that there is a point generally known as Kronecker's point in the heart, puncture of which causes the heart to stop at once and permanently. His investigations on the effect of rarefied air upon the circulation convinced him that the ascent even to considerable altitudes if unaccompanied by muscular strain is without danger, and on his report to this effect the building of the well-known Jungfrau Tunnel was begun and is now nearly completed.

Kronecker was at one time private assistant to the great physician, L. Traube, and thus possessed a knowledge of medicine quite unusual amongst mere physiologists. He was one of C. Ludwig's most esteemed pupils and dearest friends, and was at one time his assistant. At Leipzig and elsewhere he became acquainted with almost every physiologist of note, and his linguistic powers, his extensive knowledge of an encyclopædic character, his geniality, kindness, and trustworthiness converted every acquaintance he made into a friend.

Like Ludwig, Kronecker published a great deal of his work under the names of his pupils, amongst whom may be mentioned Dr. Gustav Hamel, father of the aeronaut, whose untimely death the world has recently had to deplore, and Prof. Meltzer, of the Rockefeller Institute. His influence in stimulating others was enormous, and as director of the Marey Institute in Paris, as professor in Berne, and as an actual participator in most of the physiological congresses, he put at the service of everyone who was willing to work his knowledge, his time, and his energy without stint.

The esteem in which Kronecker was held is shown by the Universities of Glasgow, Aberdeen, St. Andrews, and Edinburgh having conferred upon him the degree of LL.D., and Cambridge that of D.Sc. The number of distinctions conferred upon him by foreign universities and learned bodies is too great to mention. He served during the campaign of 1866 and the war of 1870–71, and obtained the decoration of the iron cross. His death is a great loss to physiology, and will be felt as a personal sorrow by physiologists throughout the world. LAUDER BRUNTON.

NOTES.

WE regret to announce the death on June 6, at seventy-eight years of age, of Prof. Adolph Lieben, emeritus professor of general and pharmaceutical chemistry in the University of Vienna, and foreign member of the Chemical Society.

THE death is announced, in his seventy-first year, of Dr. Barclay V. Head, correspondant of the Institute of France, corresponding member of the Royal Prussian Academy of Sciences, and keeper of the Department of Coins and Medals at the British Museum in 1893–1906.

PORTSMOUTH has been selected as the place of meeting for the autumn conference of the Institute of Metals. The conference, which will be presided over by the president, Sir Henry J. Oram, K.C.B., F.R.S., will be held on Thursday, September 10, and Friday, September 11, in the Municipal College, a number of important papers being read each morning.

THE annual June conversazione of the Royal Society was held at Burlington House on Tuesday. Most of the exhibits of apparatus and specimens were the same as were shown at the May conversazione, of which an account was given in NATURE of May 21 (p. 304), and others have been described in our reports of the proceedings of societies and academies, so that no further reference need be made to them here.

THE Aero Club of America has appointed a committee of seventy, with Admiral Peary as its chairman, to supervise the preparation of a map of the permanent air currents over the United States. The committee will begin by formulating rules for making aerial observations at points to be agreed upon in various parts of the country. Local aero clubs will then make the observations by means of balloons and aeroplane flights. The committee will also prepare a topographical map indicating convenient landing places for airmen.

A SERIES of severe thunderstorms passed over the southern area of the metropolis on Sunday afternoon, June 14. The lightning was exceptionally severe and prolonged, and torrents of rain fell with much hail at times. Six persons, of whom four were children, were killed at about one o'clock, whilst sheltered under two different trees on Wandsworth Common, and several persons were injured, one of whom has since died. Many buildings were struck by lightning, and immense damage was sustained by flooding due to the heavy rain. The damage was almost wholly limited to an area stretching from east to west, from Blackheath and Lewisham through Streatham and Wandsworth to Wimbledon and Kingston. At Streatham Hill thunder was first heard at 12.30 p.m., and the storms continued with more or less intensity until after 5 p.m. There were four distinct disturbances moving from east to west, and apparently subsidiary to the low-pressure area over France and Germany. The heaviest downpour of rain and hail occurred at Streatham Hill for a quarter of an hour, from 1.30 p.m.; at 2 p.m. the rainfall measured 1·10 in., at 4 p.m. an additional 0·45 in., and at 6 p.m. 0·05 in., giving an aggregate 1·60 in. At Wandsworth Common the rainfall by 3 p.m. measured 1·23 in., and at 4.30 p.m. an additional 0·65 in. was measured, giving an aggregate 1·88 in. At Kew the rainfall was 1·34 in., at Greenwich 0·32 in., South Kensington 0·23 in., Westminster 0·16 in., Camden Square, 0·04 in., at Hampstead nil.

THE address upon the relation of science to the modern State, and the inadequate encouragement given to the scientific discoverer, delivered by Sir Ronald Ross at the annual meeting of the British Science Guild on May 22 has produced a valuable and interesting correspondence in the *Morning Post* during the past few weeks. Sir Ronald Ross's main thesis was that however good the educational and laboratory opportunities may be, discoveries are not likely to be made so frequently if they impoverish the workers, or at least confer no benefits upon them, as is the case in Great Britain at present. He also pointed to the injustice of the treatment of scientific men by the State in accepting great services with little or no compensation, whereas for far less valuable services from other professional men high fees are paid. Readers of NATURE know how persistently the claims of scientific investigation to adequate recognition have been urged in these columns, and that an article upon the subject appeared in our issue of June 4. The letters published in the *Morning Post*, most of them by well-known men of science, should be the means of making a large section of the general public acquainted with the poor prospects, measured by monetary standards or worldly success, offered by a career devoted to scientific research in comparison with those of professions which do not demand exceptional qualities of originality and genius. The State may not be able to select and endow a race of discoverers, and it cannot assess the ultimate value of a discovery, but what it can and should do is to see that the men and women who are contributing to the advancement of knowledge are given the most generous encouragement and the fullest opportunities of carrying on their work.

AMONGST the terrible loss of life in the *Empress of Ireland* disaster in the St. Lawrence River recently there comes as a shock to all geologists and mining men interested in the occurrence of ore-deposits in the Archæan crystalline rocks of Canada the loss of one who, for the past thirty years, took a most active part in the deciphering of the structure of the earth's crust in the great crystalline areas of North America. In Dr. Barlow, Canada had the last court of appeal on the genesis of its ore-deposits. Trained first at home in Montreal, Barlow studied at McGill University under Sir William Dawson, Dr. Harrington, and other geologists, and was asked to join the technical staff of the Geological Survey in 1883 at Ottawa, under Dr. A. R. C. Selwyn. Filled with energy and enthusiasm for the science of geology, he entered the field in the province of Quebec, and later on worked hard at the nickel- and copper-bearing deposits of the Sudbury region in Ontario. In the Cobalt silver-mining areas of Ontario, throughout the Lake Timiskaming areas of crystalline rocks, in the iron-ore region of Lake Timagami, as well as in the gold-bearing areas of the Porcupine district on the Montreal River, and in the Haliburton and Bancroft region of southern Ontario, throughout the Hastings series, besides the special district of Dungannon, where corundum deposits are found, Dr. Barlow was the worker who, with unceasing energy and devotion to the solution of the difficult problems presented in these various fields, characterising nearly as many petrographical provinces, has left a record of noteworthy achievement to the science. At the March (1914) meeting of the Canadian Mining Institute, held in Montreal, he was the retiring president, and he did much for the institute and the mining fraternity to bring about close relations between the thorough-going geologist and the practical mining engineer.

THE archæological section of the Victoria Museum, Ottawa, the national museum of Canada, contains a valuable collection from the Thompson River region in the southern interior of British Columbia. In 1897, with the aid of funds contributed by Mr. Morris K. Jesup, of New York, Mr. Harlan I. Smith was enabled to make important discoveries in this little known region. The material thus obtained, which is of considerable anthropological value, has now been catalogued and described by Mr. Smith in Memoir No. 1290 of the Geological Survey of Canada. The catalogue is provided with a good series of illustrations, and is an important contribution to the ethnology of North America.

DR. ASHBY, Director of the British School at Rome, has recently delivered a lecture before the Malta Historical and Scientific Society on recent discoveries in the island. A large Roman villa has now been thoroughly examined, which shows rooms grouped round a central peristyle, with fluted columns of Malta stone, and an underground water channel leading from the great cistern of Medewict, which was excavated in 1881. The problem of the connection of the two has not, however, been determined. Opposite the villa is the Ghar Dalam cave, the exploration of which has been resumed. On the upper layer of earth pottery, both prehistoric and Punic, was discovered, mixed with the smaller bones of hippopotami and other animals, showing that the stratification had been destroyed probably by the percolation of water through the cave, which is not very far below the surface, and is even now full of moisture. These animals lived in the island while it formed part of a larger continent, and their bones were probably washed into the cave in their present state of disorder when the continent was submerged.

MR. J. P. BUSHE-FOX reported at the last meeting of the Society of Antiquaries the results of excavations at Hengistbury Head, lying east of Bournemouth, and forming the south side of Christchurch Harbour. The place was occupied from Neolithic times, and interments supplied Bronze age pottery, an incense cup, gold, amber, and bronze articles. In England it had hitherto been extremely difficult to fill in the gap between the end of the Bronze age and the period immediately preceding the Roman occupation; but the discovery at Hengistbury Head of a complete series of pottery linking up with the Hallstatt and La Tène periods is of great value. Perhaps the most interesting discovery was of more than 4000 gold, silver, and bronze coins, most of them British, and a large number of new types. The coinage of Gaul and Britain was largely copied from Greek originals, principally a coin of Philip of Macedon, about the middle of the fourth century B.C. The head and chariot on this coin had become so degraded by copying that the original pattern had been entirely forgotten. Most of the Hengistbury coins belong to the last stage of this type, and many of them are covered with little more than dots and lines. With them were associated Roman coins dating as late as the middle of the second century A.D. As many of the British examples were in mint condition, this part of the country had evidently been little affected by the Roman occupation of more than a century before.

MR. CLARENCE B. MOORE records in vol. xvi. of the Journal of the Academy of Natural Sciences of Philadelphia, 1913, under the title of "Some Aboriginal Sites in Louisiana and in Arkansas," the results of his archæological investigations of 1912–13. He covered ground previously unexplored by archæologists, but unfortunately the finds were very meagre and on the whole uninteresting, partly because the area in question is subject to floodings, and therefore the destruction or the impairment of mounds is not permissible. Nevertheless, the district had to be investigated in order to complete the scheme which Mr. Moore has imposed on himself, despite the fact that he knew he would be unlikely to get many specimens. It is this attitude of mind, the patient accumulation of data irrespective of their intrinsic worth and disregard of sensational results, that gives Mr. Moore a distinguished place among archæologists. Many of the mounds are quadrangular, with the sides facing the cardinal points, frequently they are about 15–20 ft. in height, and have a square flat summit, sometimes 100 ft. or more in diameter. In addition to the usual wealth of excellent figures of pottery, etc., there are two coloured plates, one of a large effigy-pipe of earthenware, the other of irregular earthenware objects of unknown significance. Those that are biconical may have been used in the "hand-game," a gambling game universally spread over North America, possibly some of the other objects may have been used for similar purposes; at present they remain a mystery. The memoir closes with a short report on a collection of crania and bones by Dr. A. Hrdlička. The skulls were slightly deformed artificially, and "are remarkably like the less narrow type of crania among the Siouan people and the more southern Iroquois."

THE Milk and Dairies Bill passed the second reading on June 9. On the whole a favourable opinion was expressed with regard to it, though Mr. Astor thought there was a real fear that it might seriously diminish the quantity of milk available, and so tend to increase its price. He also urged the grading of milk.

THE annual report of the superintendent of the Brown Institution (Mr. F. W. Twort) has been issued. Some 6000 animals were brought to the institution, of which 565 were treated as in-patients. In addition to its hospital, important research work is carried out in the laboratories of the institution—investigations on Johne's disease of cattle, by Dr. C. Twort; the functions of the thyroid gland, by Mr. Edmunds; infantile diarrhœa, by Dr. Mellanby and the superintendent, etc.

As is well known, those engaged in occupations in which much siliceous dust is produced (*e.g.* potters, certain miners, etc.) suffer from a form of lung disease. Dr. McCrae has analysed the lungs from such cases occurring in the Witwatersrand mines, South Africa. He finds that from 2·8 to 9·6 grams of silica may be present, compared with 0·55 gram in a normal lung. Microscopical examination of the siliceous particles showed them to be angular, and the majority have a diameter of less than 1 μ (South African Institute for Medical Research, 1913).

WE have received from the publisher, Mr. Gustav Fischer, Jena, "Studien zur Pathologie der Entwicklung" (Band i., Heft 3, 1914), edited by Profs. R. Meyer and E. Schwalbe. The principal contribution is by Dr. L. Kech on the morphology of the musculature of the human extremities when defective (pp. 428–539), containing a summary of published examples. Abstracts of papers published elsewhere, as well as original communications, are included in the volume, which should be of considerable service to those engaged in this branch of research.

A REPORT of the work of the Radium Institute for the year 1913, by the director, Mr. Hayward Pinch, has been issued. In all, 860 cases have been treated, of which about half were cases of cancer. A number of the latter improved more or less, but it is too early yet to determine whether they be cured or not. It would seem that in cases of cancers of the skin the outlook is very hopeful, but that in tumours of the tongue and mouth it is less hopeful—though the method of burying the radium tube in the tumour has been successful in some cases. Tumours of the womb yield gratifying results, of the breast fair results. Intestinal tumours, though difficult to reach, do well in a relatively small number of cases. Tumours of bone, if taken early, do well. In most cases pain and irritation are relieved. Besides the direct application of radium in the institute, tubes of radium emanation and radio-active water are supplied for use outside.

IN his report for 1913 the curator states that the Sarawak Museum has made steady progress, the number of additions during that year being above the average, and articles based on the collections more numerous than usual. The crying need of the moment seems to be the expansion and (when necessary) description of the large collection of Bornean beetles.

WITH its June issue the *Entomologist's Monthly Magazine* celebrates its jubilee, the first number, under the editorship of Messrs. Stainton, McLachlan, Rye, Blackburn, and Knaggs, having appeared in June, 1864. Of the contributors to the first volume, eight well-known entomologists—Messrs. A. G. Butler, F. Enock, C. Fenn, G. Lewis, G. B. Longstaff, G. F. Mathew, D. Sharp, and G. O. Waterhouse are still with us to testify to the healthfulness of "butterfly-hunting." Since its commencement, the magazine has added no fewer than 2992 species to the British fauna.

LICE (Anoplura) and biting-lice (Mallophaga) infesting mammals form the subject of an article in the May issue of the *American Naturalist* by Prof. V. L. Kellogg, of Stanford University, Colorado. In a previous communication on the Mallophaga of birds it has been shown that the evidence of these parasites frequently confirms that of other factors in respect to the near affinity between hosts that are widely sundered geographically. Similar evidence is afforded by the study of the mammal-infesting types, the author remarking that, in spite of the incompleteness of our knowledge, "it is surprising how repeatedly the commonness of parasite species to two or more related, although geographically well separated, host-species is illustrated. All through the order (*i.e.*, class) from Marsupials to Quadrumana this condition is again and again exemplified."

As the result of collecting trips in the Middle and Far East, followed by technical work in the chief museums of Europe, Mr. C. W. Beebe has evolved a scheme of classification of the pheasants and their relations, based on the order in which the tail-feathers are moulted, a feature he believes to afford the most trustworthy indication of genetic affinity. In this he is in agreement with the work of Dr. Bureau on the tail-moult in partridges, although he was unacquainted with those researches until his own were nearly completed. On this basis Mr. Beebe (whose article appeared in the April issue, vol. i., No. 15, of *Zoologica*) divides the pheasant family (Phasianidæ) into four sub-families. In the first of these (Perdicinæ) the tail-moult commences with the inner pair of feathers, while in the second (Phasianinæ) the outermost pair are the first to be shed; in the other two sub-families an intermediate condition exists.

A NEW method for determining the densities of minerals and rocks at high temperatures is described by A. L. Day, R. B. Sosman, and J. C. Hostetter, in the *American Journal of Science*, vol. xxxvii. (1914), p. 1. The substance is held down by weights under an inverted crucible of graphite, which is immersed in a bath of molten tin or silver. Tin has the conveniently low melting point of 232°. The measurements are made by noting the weight required to pull down the crucible and the assay to a given depth marked on a stem connected with the crucible. The graphite is protected from oxidation by an atmosphere of nitrogen and carbon monoxide. The density-curve of the metal used and the expansion-coefficient of graphite are, of course, factors in the calculation of the results. One of the most interesting of these is that as the temperature (575°) at which α-quartz passes into β-quartz is approached, a striking increase occurs in the rate of expansion.

The area of German East Africa to the south-east of the Victoria Nyanza and south of the frontier of British East Africa was explored in 1906–7 by Prof. Fritz Jaeger, Professor of Colonial Geography in Berlin, and his report on the Riesenkrater Highlands includes a detailed account of the interesting area which he investigated. It has been issued in the *Mitteilungen aus den Deutschen Schutzgebieten, Ergänzungsheft*, No. 8 (1913, 4to, 213 pp., 12 pl., 3 maps). The most interesting general problem in the area is the course across it of the Great Rift Valley of East Africa. The western wall of this valley continues southward, forming the western scarps above lakes Magadi, Manyara, and Balangda; but the eastern wall disappears in a wide volcanic belt which extends westward from the extinct volcanoes of Kilima Njaro, and Meru. In the same district a series of faults branches off from the western wall of the Great Rift Valley and trends south-westward; these faults give rise to a series of rift valleys of which the largest includes the plains of Wembere and Lake Njarasa; a smaller one, Prof. Jaeger has called the Hohenlohe-Graben. These valleys may be really off-branches, and the main valley probably continues southward; its eastern wall may be represented by some faults, with a throw of more than 600 ft., which lie along the southern extension of the eastern side of Lake Manyara. The memoir includes a detailed account of the volcanic highlands to the north and west of Lake Manyara, which Prof. Jaeger has called the Riesenkrater Hochland.

R. E. Liesegang's suggestions and experiments as to the osmotic deposition of concentric coats in chemical and mineral aggregates have received considerable attention among geologists, and notably from Mr. G. Abbott (Nature, vol. xcii., pp. 607 and 687). Mr. Abbott has now published in the *Pioneer* (March 20 and 27, 1914) a further study of the discoid limestones which simulate organic characters in the concretionary beds of Permian age at Sunderland, and suggests that we must not ignore processes of mineral growth "even in the evolution of well-known organisms, such as corals." We must not, he urges, "remain blind to what the alkaline earths *can of themselves* do in the formation of the skeletons of higher structures, in the roll of living things." Mr. E. A. Martin, Hon. Curator of the Museum of the Borough of Croydon, South Norwood, writes to us on the same subject, pointing out that the secretion of carbonate of lime or silica by marine organisms may be "immensely assisted by the osmotic action which Mr. Abbott believes to have been the cause of the discoid and coralloid growths of the limestones of Fulwell Hill." "Has this, too," he asks, "anything to do with the reason why some shells are spiral, discoidal, bivalve, and so on?" Here the question appears to be one for the zoologist, who may be able to indicate a cause in the grouping of the soft parts of the animal, by which the external skeleton is controlled.

A first communication on the motion of the air in the lowest strata of the atmosphere, by Prof. G. Hellmann, appeared in the *Sitzungsberichte* of the Prussian Academy of Sciences of April 2. As pointed out by the author, of all the meteorological elements determined by instruments, none lacks comparability between one place and another like wind velocity. This is due to some extent to instrumental defects, but more particularly to the extraordinary differences of exposure, especially height above the ground. Experiments are being carefully made by the Berlin Meteorological Institute at heights of 2, 16, and 32 metres, the results of which show an annual mean increase in velocity of 48 per cent. between 2 and 16 metres, but only 14 per cent. between 16 and 32 metres; it is proposed to erect additional instruments at greater heights. Little variations in the increase of velocity with height were found to exist during the monthly periods, except at the lowest level, owing to friction with the surface. Some very interesting and unexpected results are referred to with respect to the completely opposite behaviour of the daily range of velocity in light and strong winds. The systematic study of the vertical wind components, such as those now in question, is of great importance at the present time.

In the May number of the Proceedings of the American Academy, Dr. Louis Bell gives an account of an investigation of the types of abnormal colour vision he has commenced with the aid of the Rumford Fund. His spectroscopic apparatus allows him to classify his cases very rapidly. It depends on matching a synthetic yellow and a synthetic blue-green, which lie at the points of intersection of the red-green and the blue-green sensation curves for the normal eye, by a pure spectrum which occupies the lower, while the synthetic colour occupies the upper half of the field of view. Of the twenty-six types of abnormality, Dr. Bell has already investigated the six possible types characterised by deficiency or excess of sensitivity to one of the three fundamental colours, five of the twelve possible cases in which two of the fundamental sensations are affected, and four of the eight possible cases in which three of the sensations are abnormal. He points out that the direction in which we must look for remedial measures is that of reducing the stronger sensation or sensations by means of coloured spectacles till the three are in the normal ratio. This can only be done in the deficiency cases at the expense of the general luminosity.

Part 3 of vol. iii. of the Science Reports of the University of Sendai, Japan, contains two important magnetic papers. The first, by Messrs. K. Honda and Y. Ogura, deals with the relation between the changes with temperature of the electrical resistances and the magnetic susceptibilities of iron, steel, and nickel. The materials were tested in the form of wires about a metre long and a millimetre in diameter. The magnetic field of about 160 was produced by coils, and the magnetisation measured by the magnetometer method up to temperatures of 800° or 900° C. The results show that the changes of conductivity and susceptibility occur together, and that both are due to gradual changes of the properties of one of the phases rather than to any change of phase of the constituents. The second paper, by Messrs. H. Takagi and T. Ishiwara, gives the susceptibilities of a large number of minerals and igneous, aqueous, and metamorphic rocks, tested by the non-uniform field method up to fields of 2600. In general, igneous rocks are strongly paramagnetic, and their susceptibilities decrease with the field, while the other rocks are weakly paramagnetic or diamagnetic, and their susceptibilities nearly independent of the field.

Bulletin No. 42 of the experiment station of the Hawaiian Sugar Planters' Association contains an account by Mr. Noël Deerr of an experimental study in multiple effect evaporation. From these experiments it appears that the temperature difference in the first cell is a rough index of the rate of evaporation, and that the vapours in a multiple effect evaporator are superheated. The heat economy of quadruple effect evaporators as found in practice compared with a computation on ideal lines lay between 0·8 and 0·9, the latter figure being obtained with well protected, and the former with unprotected, or badly protected apparatus. A vertical submerged tube apparatus with 5-lb. gauge pressure in cell No. 1 (227° F.), and not less than 26·5 in. vacuum in the last cell (127° F.) should evaporate not less than 9 lb. of water per sq. ft. an hour, with juice entering at 212° F., and should evaporate 4·2 lb. of water per lb. of steam. If these results are not realised, foul heating surfaces, too slow evacuation of condensed waters, or incondensible gases may be looked for. A horizontal tube film evaporator had a much greater rate of evaporation than vertical submerged tube evaporators.

The recent pronouncement of Sir Percy Scott that the importance of submarines has not been fully recognised, and that it has not been realised how completely their advent has revolutionised naval warfare forms the subject of articles in *Engineering* and the *Engineer* for June 12. Sir Percy has said that, in his opinion, as the motor vehicle has driven the horse from the road, so has the submarine driven the battleship from the sea. These statements have encountered a good deal of criticism, and neither of our contemporaries advocates the interpretation that we should discontinue the building of battleships. It cannot be said that Sir Percy has adduced convincing reasons for the complete change in naval policy which he advocates. It has not been established that the torpedo, practically the only weapon of the submarine boat, would be effective. Again, the radius of action of such boats when submerged is very limited, not much more than one hundred miles, so that in taking a considerable voyage they would have to proceed "awash," and would then be subject to attack by torpedo-boat destroyers and other surface craft, and by aerial vessels.

Members of the British Association about to proceed to Australia for the meeting in August next, and students of geography generally, should examine the large scale map of Australia just published by Messrs. G. W. Bacon and Co., Ltd. The size of the map is 72 in. by 56 in., and it can be had in four sheets, mounted to fold in neat cloth case for the bookshelf, at the price of 25*s*. The map is constructed on Clarke's Perspective Projection, and the scale is 1 : 2,500,000, or 39·5 miles to the inch. Rivers, lakes, and similar physical features, are shown and named in blue, while black type is used for place-names, mountains, and so on. Roads, tracks, and telegraph lines are marked in red. Inset maps on the same scale are provided of Tasmania and Papua. The map is also published mounted on cloth with rollers, in which form it will prove very useful in the office and study.

Mr. S. J. Barnett writes from the Ohio State University, U.S.A., to say that the word "size" in the penultimate line of the second column of p. 109 of the current volume of Nature, on which a letter from him is printed, should be "sign." We have examined Mr. Barnett's original MS., and in view of the indistinct character of the handwriting understand how the misprint occurred.

OUR ASTRONOMICAL COLUMN.

The New Zealand Solar Observatory.—In an address to the members of the Wellington Philosophical Society, by the president, Dr. C. Monro Hector, the subject dealt with was the present state of affairs as regards the Cawthron Solar Observatory. Referring first of all to the approval of all the leading authorities in both Europe and America for the establishment of such an observatory, he points out the suitability of the neighbourhood of Nelson as the site. The records show that this region has 20 per cent. more sunshine and 33 per cent. less rain than at the Kodaikanal Observatory in India. Several excellent sites about Nelson are available, but that on the Port Hills, within easy reach of the town, has so far proved the best from an observational point of view; if this be eventually selected, it will be a means of saving much money in initial outlay and running expenses. Mr. Thomas Cawthron has promised the 50,000*l*. for a beginning, being the estimated minimum for establishing the observatory on a continuous and permanent basis; a suggested deed of trust has been drawn up, and a suggested board of trustees has been submitted to him and approved. The proposed constitution of the board is as follows:—Mr. Thomas Cawthron, one member nominated by each of eight institutions, the Government Astronomer, and two others elected by the rest of the board.

The Positions of Variables and Asteroids Discovered at the Lowell Observatory.—Bulletin No. 61 of the Lowell Observatory contains a communication by Mr. C. O. Lampland with reference to the positions of variables and asteroids discovered on photographs of star fields taken with the 40-in. reflector of the Lowell Observatory. During the past year about 800 negatives have been made and examined, and measures were made with a Zeiss comparator equipped with a Blink Mikroskop. All the areas were photographed in duplicate, and the exposures were from two to three days apart on the average. The settings at the telescope were made on the intersections of the hour-circles and parallels of declination (at intervals of four minutes in R.A. and 1° in declination) in Schönfelds and Gould's *Durchmusterung* charts, so the plates (7×5 in.) in their longest direction have considerable overlap, the linear scale of the negatives corresponding to one degree of arc being 3·8 in. Mr. E. C. Slipher was a co-worker at the telescope, and with the examination of the negatives, but Mr. Lampland is responsible for the magnitudes and determinations of position which accompany the paper in the form of tables. Nearly all the objects dealt with are of magnitude about 12 or fainter.

RADIAL VELOCITIES OF 100 STARS WITH MEASURED PARALLAXES.—Messrs. W. S. Adams and Arnold Kohlschütter contribute a valuable paper to the May number of the *Astrophysical Journal* (Contributions from the Mount Wilson Solar Observatory, No. 79) relative to the radial velocity determinations during the past three years of stars fainter than magnitude 5·5 on the visual scale for which observations of parallax are available. The photographs were secured with the 60-in. reflector in conjunction with the Cassegrain spectrograph adapted for use with one prism, but for stars from 5·5 to 6·5 magnitude a camera lens (Brashear special triplet) of 102 cm. focal length was used, while for stars fainter than 6·5 a lens (Cooke astrographic type) of 46 cm. focal length was employed. Briefly summarising some of the conclusions derived from this excellent piece of research work, the first to be mentioned is the enormous radial velocities of a few of the stars observed. Thus Lal. 1966 and Lal. 15290 indicated velocities of −325 and −242 km., the first of these being the highest recorded radial velocity among any of the stars. Four other stars exceeded 100 km., and several between 75 and 100 km. A notable fact is the great preponderance of large negative over large positive velocities, no less than 75 per cent. of the large velocities observed being negative. The following interesting table shows the stars exceeding radial velocities of 50 km. with their spectral types, showing that nearly all classes of the latter are involved:—

Positive (5)			Negative (15)		
Groom. 864	G0	+100	Lal. 1045	K1	−58
Groom. 1281	F9	84	Lal. 1966	F3	319
20 Leo. Min	G1	54	Lal. 4855	G0	103
33 Virginis	K1	56	Lal. 5761	A3*p*	151
Lal. 30694	G5	+57	Lal. 15290	F7	250
			Lal. 21185	Ma	85
			Lal. 27744	G9	58
			OΣ 298	K0	55
			W.B. 15h 720	G9	54
			Lal. 28607	A2*p*	158
			72 ω Herculis	G0	59
			31*b* Aquilæ	G7	80
			Lal. 37120-1	G2	143
			Lac. 8381	K6	50
			Pi 23h 164	F8	−59

It will be noticed that the two stars with the largest proper velocities are of types F3 and F7, and the two succeeding stars are of the A type.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THIS congress will be held at the Imperial Institute on June 23–30. Meetings will commence each week-day at 10.30 a.m., except on Saturday, which will be devoted to special visits. The mornings, as a rule, will be devoted to discussions, and the afternoons to papers on special subjects. Only a few of the more important matters to be dealt with can be mentioned here, and those interested should consult the general programme, which can be obtained on application to the general secretaries at the Imperial Institute, South Kensington, S.W.

At the inaugural meeting on June 23, the president, Prof. Wyndham R. Dunstan, will receive the delegates of the foreign and colonial Governments, and will deliver the presidential address. In the afternoon he will preside at a discussion on "Technical Education in Tropical Agriculture," to which Mr. Dudgeon (Egypt), Dr. Francis Watts (West Indies), Mr. Lyne (Ceylon), Mr. McCall (Nyasaland), and others will contribute.

An interesting feature of the congress will be a series of four special papers to be given on certain afternoons. On Tuesday, June 23, Mr. J. A. Hutton, chairman of the British Cotton Growing Association, will describe the work of that association. The Earl of Derby, president of the association, will take the chair, and Lord Emmott, Under-Secretary of State for the Colonies, will speak. In the same series Sir Louis Dane will preside at a meeting on Thursday afternoon, at which Mr. Shuman will describe the "Utilisation of Sun-power for Irrigation and Other Purposes"; on Friday afternoon Prof. Wallace will lecture on "The Caracul Sheep"; and on Monday afternoon, June 29, Mr. Wigglesworth will describe "The Fibre Industry of British East Africa."

On Wednesday morning, June 24, two discussions will be held; the first, presided over by Sir Ronald Ross, will deal with "Hygiene and Sanitation on Tropical Estates," and the second, at which Sir Sydney Olivier will take the chair, will be concerned with "Legislation against Plant Diseases," to be introduced by a paper from Mr. A. G. L. Rogers, of the Board of Agriculture.

On Thursday morning the president will introduce a discussion on "The Factors which Determine Variation in the properties of Plantation Rubber, with Special Reference to its Uses for Manufacturing Purposes," to which planters, manufacturers, and others will contribute. In the afternoon Sir E. Rosling will preside, and papers on rubber will be read.

On Friday morning the first discussion will be on "Agricultural Credit Banks and Cooperative Societies," at which Sir Horace Plunkett will preside. The second will be on "The Organisation of Agricultural Departments in Relation to Research," and at this the President will take the chair.

On Monday, June 29, Viscount Kitchener will take the chair at a discussion on "The Improvement of Cotton Cultivation," at which papers will be read by Mr. Dudgeon (Egypt), Prof. Todd (Nottingham University), Mr. Arno Schmidt (International Federation of Cotton Spinners), and Mr. McCall (Nyasaland). The afternoon will be devoted to sectional meetings for papers on "Cotton" and on "Jute and Hemp Fibres."

Tuesday, June 30, will be the last day of the congress. Two sectional meetings for "Cotton" and "Miscellaneous" papers will be held in the morning, and the final meeting of the congress will be held at 3.30 p.m. in the afternoon.

His Majesty the King has graciously consented to become patron of the congress, and His Majesty's Government will give a reception for the delegates and members of the congress at the Imperial Institute on Tuesday, June 23, at 9.30 p.m. Receptions will also be given by the Royal Colonial Institute (June 24) and by the Rubber Growers' Association (June 30).

The subscription for membership, including all publications of the congress, is 1*l*.

OPENING OF THE NEW PHYSIOLOGICAL LABORATORY AT CAMBRIDGE.

HONORARY DEGREES CONFERRED.

THE Public Orator (Sir John Sandys) delivered the following speeches in presenting to the Chancellor (Lord Rayleigh) the several distinguished recipients of the honorary degrees conferred on the occasion of the opening of the new physiological laboratory at Cambridge on June 9:—

Hon. LL.D.

H.R.H. PRINCE ARTHUR OF CONNAUGHT, K.G., K.T., G.C.V.O.

Gratias, quae Principi feliciter ad nos advecto patria in lingua feliciter redditae sunt, etiam Academico in sermone eidem libenter reddimus. Salutamus Victoriae Reginae et Principis Alberti, Cancellarii nostri, nepotem acceptissimum, Ducis Arthuri filium unicum, Principem patriae devotissimum, Principem in luce publica plurima cum laude versatum. Regis nostri in nomine olim ad extremam Orientis oram honoris causa plus quam semel missus est; Regia artium in Academia nuper pictoribus nonnullis consilia sobria, consilia sana, commendavit; nostram denique ad litterarum et scientiarum Academiam hodie allatus, aedificium novum physiologiae studiis dedicatum auspiciis optimis mox inaugurabit. Physiologiae inter leges memoratu dignum est Horatianum illud:—"fortes creantur fortibus et bonis." Iuvat igitur Ducis fortissimi et optimi, abhinc annos undecim Doctoris nostri nominati, heredem dignissimum laurea eadem hodie coronare.

THE RIGHT HON. VISCOUNT ESHER, G.C.V.O., G.C.B., M.A., Trinity College.

Sequitur deinceps iudicis summi, alumni nostri, filius, vir et inter Etonenses et in Collegio nostro maximo educatus, deinde regni totius senatoribus suffragio electis per quinquennium additus, Ducis Devoniae Cancellarii nostri filio, postea Cancellario nostro, fere eodem tempore adiutor acerrimus. Nuper etiam Academiam nostram magnopere adiuvit, et aliorum in nos liberalitatem generosissimam excitavit. Viri huius ductu prospero, aureus ille donorum rivus Academiae nostrae in silvas defluxit; eiusdem auxilio, etiam in clivo quodam saluberrimo salutis templum illud nuper aedificatum est, ubi hereditatis (ut aiunt) leges professor noster novus investigabit, cuius cathedra alumni nostri magni nomine in perpetuum ornabitur, Arthuri Balfour. Ergo, in colle nobis propinquo, a professore nostro, etiam in aliis rerum naturae provinciis, Horatianum illud verum esse comprobabitur:—

est in iuvencis, est in equis patrum
virtus, neque imbellem feroces
progenerant aquilae columbam.

THE RIGHT HON. BARON MOULTON OF BANK, M.A., F.R.S., Honorary Fellow of St. John's, and late Fellow of Christ's.

Adsurgit proximus Collegii Divi Ioannis alumnus, vir abhinc annos quadraginta sex in studiis mathematicis locum omnium summum adeptus, qui, Christi in Collegio socius electus, etiam iuris in provincia honorum publicorum ad culmina summa pervenit. Olim in legibus ad scientiam machinalem pertinentibus inclaruit; nuper etiam medicinae de scientia illo die praeclare meritus est, quo experimenta quaedam generis humani saluti necessaria esse luculenter comprobavit. Ergo non modo Archimedis sed etiam Aesculapi alumnis iure optimo erit acceptissimus. Ceterum haec omnia, peritis non ignota, hodie neque (ut Tullius ait) ad vivum resecanda, neque (ut mathematici dicunt) ad infinitum producenda. Inter omnes constat iudicem tam conspicuum iuris doctorem hodie merito creari.

COLONEL STARLING MEUX BENSON, Master of the Drapers' Company.

Inter societates illas Londinienses, quae divitiarum amplitudine et liberalitatis laude excellunt, una est quae propterea nostrum omnium animis identidem obversatur, quod non modo agri culturae studium inter nos magnopere adiuvit, sed etiam, munificentia hodie imprimis memorabili, aedificium novum physiologiae studiis dedicatum nobis donavit. Ut in societatem illam munificam animum nostrum gratum aliquatenus indicemus, societatis totius magistrum titulo nostro libenter decoramus, virum qui, olim inter milites spectandus, linteorum (ut aiunt) in societate liberalissimâ, pacis in artibus iam dudum floruit. Hodie saltem "cedant arma togae," dum militum tribunum, etiam pacis in artibus praeclarum, purpura nostra honoris causa vestimus.

Hon. Sc.D.

SIR WILLIAM OSLER, Bart., M.D., F.R.S., Regius Professor of Medicine, Oxford.

Caritatis vinculo triplici nobiscum est coniunctus medicus illustris, vir inter fratres nostros Canadenses et inter consobrinos nostros transmarinos medicinam praeclare professus, et inter sororis nostrae venerabilis, sororis nostrae Oxoniensis silvas, professoris medicinae regio munere ornatus. Peritis nota sunt ea, quae, aut solus aut cum aliis consociatus, in magna voluminum serie de medicina disputavit. Pluribus loquuntur ea quae de animo aequo, de consiliis ad vitae finem perfectum spectantibus conscripsit. Nobis autem idcirco potissimum dilectus est, quod medicinae, litterarum renascentium in saeculo, studiis devotissimus, inter nosmet ipsos egregie laudavit virum et de Oxoniensibus et de Cantabrigiensibus praeclare meritum, regiae medicorum societatis conditorem illum, Thomam Linacre.

SIR DAVID FERRIER, M.D., F.R.S., Emeritus Professor of Neuropathology, King's College, London.

Progreditur deinceps vir inter Aberdonenses, Edinenses, Heidelbergenses olim educatus, inter Londinienses denique et "neuropathologiam" (ut aiunt) et artem medendi praeclare professus. Viri huius et collegarum eius peregre docentium experimentis didicimus, cerebri duplicis corticem non totum corporis totius motus moderari, sed partem aliam ad aliam corporis partem pertinere; cerebri in parte una videndi sensum, in alia sensum audiendi collocari. Tali autem ex scientia morborum varietates quaedam melius inter sese dignoscuntur, vitaeque humanae dolores multum minuuntur. Abhinc annos quattuor et triginta inter doctores nostros honoris causa libenter numeravimus generis humani amicum illum, Iosephum Lister: hodie vero, saeculo in novo, etiam alium generis humani amicum titulo nostro non minus libenter decoramus.

SIR EDWARD SCHÄFER, F.R.S., Professor of Physiology, Edinburgh.

Urbis Edinensis, Athenarum illarum Caledonicarum, Academia ad nos misit physiologiae professorem illustrem, cuius opera, ad histologiae et physiologiae scientiam pertinentia, physiologiae et medicinae studiosis iam dudum cognita sunt. Omnibus autem nota sunt experimenta illa, per quae homines in fluctibus submersi, respiratus artificiosi auxilio, ad vitam revocantur. Olim rex ipse Olympi Aesculapio propterea invidisse dicitur, quod, Hippolyto ad vitam revocato, iura Plutonis imminuisset. Nunc autem omnibus penitus persuasum est, nihil quod hominum saluti prosit, summo Patri posse displicere. Non immerito igitur illos in honore habemus, quorum auxilio mortis imperium inter terminos artiores contractum vidimus.

MR. ERNEST HENRY STARLING, M.D., F.R.S., Professor of Physiology, University College, London.

Agmen nostrum claudit hodie Universitatis Londiniensis in Collegio quodam illustri professor insignis. Physiologis notum est sanguinis nostri partem quandam e venis quibusdam subtilissimis per corporis telas propinquas textu tenuissimas exsudare, et corpori alimenta quaedam nova ministrare. Viri huius praesertim experimentis sudoris illius ratio universa explicata est, qui etiam vitam corporis iam mortui in corde et pulmonibus conservatam, et partium superstitum motus, investigare potuit. Talium virorum ingenio, vocabulo quodam a lingua Graeca derivato, quod *hormone* dicitur, res quaedam chemica patefacta est, quae, ex alia corporis parte intima, parti alii stimulos addit, hinc illuc velut nuntia quaedam transmissa. Etiam physiologiae in studio quicquid novi aliunde ad nos advectum est, etiam nobis novos stimulos addit. Ergo etiam hunc virum, rerum exterarum nuntium ad nos advectum, decoramus, qui tot collegas suos non modo industriae et laboris sed etiam gloriae et honoris stimulis concitavit.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

THE annual report of the president of the Carnegie Foundation for the Advancement of Teaching shows a total endowment of 3,065,000*l*., and an expenditure for the year ending September 30, 1913, of 131,686*l*. Of this 103,888*l*. were distributed in retiring allowances to professors, and 16,150*l*. in pensions to their widows. Thirty-three allowances were granted during the year, making the total in force 403, the average annual payment to an individual being 340*l*. The total distribution from the beginning has been 587,385*l*. The educational work of the foundation was separately endowed in January, 1913, by a gift of 250,000*l*. from Mr. Carnegie through the Carnegie Corporation of New York. This body, which is endowed with 25,000,000*l*. for "the advancement and diffusion of knowledge and understanding," has five ex-officio trustees, of whom one must always be the president of the Carnegie Foundation for the Advancement of Teaching.

In connection with the foundation's work as a centre of information concerning pensions, the president, Mr. H. S. Pritchett, discusses pension systems that are maintained by half a dozen colleges, the development of new systems at Brown University, the Rockefeller Institute, and the American Museum of Natural History, the new federated pension system of the English universities, and the proposed system for the clergy of the Episcopal Church. Among pensions for public-school teachers the report discusses the New York City system and the new State system in Massachusetts.

At the Rockefeller Institute for Medical Research the pensions are stipendiary in character, being three-quarters of the last annual salary to those retiring at the age of sixty-five, after fifteen years of service. Retirement is also permitted at the earlier age of sixty, after fifteen years of service, the pension in this event being one-half of the last annual salary, plus 10 per cent. for each year of service in excess of fifteen. These pensions are offered only to members and associate members of the institute, of whom there are now twelve. The maximum for retiring allowances is high, being set at 2000*l*. The rules repeat the rule of the University of Chicago, that "the obligation to pay retiring allowances will be neither greater nor less than the obligation to pay salaries; so that if misfortune shall compel a percentage reduction of salaries, retiring allowances may be reduced in the same proportion."

Much of the report is devoted to the development of the educational work of the foundation into a separate division of educational inquiry. Its recent work includes a study of education in Vermont at the request of the Vermont Educational Commission, of legal education at the request of a committee of the American Bar Association, and of engineering education at the request of a joint committee representing the national engineering societies. Plans for the study of engineering education are now being completed.

The earlier educational work of the foundation is continued in the report by commendation of the present tendency of college entrance requirements toward both elevation and flexibility. The need for further improvement is shown by the fact that only 55 per cent. of the students now in American colleges are high-school graduates. The decrease in the number of medical schools in the country from 162 in 1910 to 115 in 1913, and the rapid improvement of the better schools are commented upon with appreciation. A general study of the problems of the State regulation of higher education is provided.

An interesting tabular statement is provided which sets out the total number of students in 807 universities and colleges in the United States, and also the number of these, who, having passed college entrance examinations and requirements, rank as collegiate students. In the 807 institutions there are in all 330,832 students, of whom 183,089 are students of college grade. In each of ten States there are upwards of 10,000 students registered in these places of higher education, and the following extract from the table shows the number of students of college standing in each case.

State	Institutions	Total number of students	Students of college grade
Illinois	40	26886	14269
New York	32	24214	19365
Pennsylvania	40	23633	13279
Ohio	45	22704	14126
Indiana	25	14635	7653
Massachusetts	17	14341	13859
Iowa	40	13251	6607
Texas	37	12653	4405
Kansas	26	11563	5654
California	19	11376	7864

There has been in the last five years a marked recrudescence of State activity with regard to higher institutions of learning. In a number of States the president of the State university has been dismissed, whether justly or unjustly, in a peremptory manner. In other States there has been legislation with respect to the differentiation of State institutions. In still others the regulation of degree-granting powers has occupied the attention of legislators. On the whole, the last five years have been distinctly marked by the activity of legislative authorities concerning the State institutions, and by the evidences of some awakening as to the need for the regulation of all higher institutions of learning. Whatever may be the immediate outcome of this movement, it is probably a hopeful sign of the beginning of a successful effort to differentiate State institutions and to bring within fair limits the degree-granting powers of endowed institutions.

The report further presents a study of the financial status of college teachers as compared with the situation presented in a similar study published five years ago. The ordinary salary of a full professor in the institutions associated with the foundation is now 600*l*. During the last five years the salaries of instructors have risen by about 16*l*.; those of junior professors show a gain of from 24*l*. to 45*l*.; those of full professors show an increase from 25*l*. to 70*l*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced in *Science* that Lafayette College is a beneficiary under the will of the late Mr. William Runkle to the amount of 20,000*l*.

News has been received by cable that Prof. T. R. Lyle, F.R.S., is shortly to resign his professorship in the University of Melbourne, and that in consequence the chair of natural philosophy will become vacant. The salary attaching to the post is about 1000*l*. per annum, and the new occupant of the chair will be expected to take up his duties in February next, which is the beginning of the session.

The following gifts to higher education in the United States are announced in the issue of *Science* for June 5:—20,000*l*. anonymously for the erection of the first of Cornell University's residential dormitories; an unrestricted gift to Harvard University of 10,000*l*. by Mr. Nathaniel H. Stone; 5000*l*. under the will of Miss Elizabeth S. Shippen to the University of Pennsylvania; and 4000*l*. and a contingent interest in one-third of a 10,000*l*. fund to the Hampton Normal and Agricultural Institute by the late Mr. Robert C. Ogden.

Lord Rosebery has been elected president of the University of London Club, and the following have been elected vice-presidents:—Sir Thomas Barlow, Sir Robert Blair, Sir John Rose Bradford, Dr. Sophie Bryant, Sir Edward H. Busk, Mr. Clifford B. Edgar, Lord Emmott, Sir Rickman Godlee, Sir Alfred Pearce Gould, Dr. W. P. Herringham, Prof. M. J. M. Hill, Sir Alfred Hopkinson, Sir Joseph Larmor, Sir Oliver Lodge, Sir Philip Magnus, Sir Henry A. Miers, Lord Moulton, Sir William Ramsay, Sir Henry E. Roscoe, Sir William A. Tilden, Prof. H. H. Turner, and the Right. Hon. T. McKinnon Wood. The committee has elected 910 original members of the club, 709 men and 201 women. Mr. T. Ll. Humberstone has been appointed the first secretary of the club, and it is hoped that the club-house at 19 and 21 Gower Street will be open in July or soon afterwards.

The annual report for the present year of the Nantucket Maria Mitchell Association has been received. One of the most useful of the activities of the association has been the provision from time to time of an astronomical fellowship, to which Miss M. Harwood was reappointed in March, 1913. Her research work, executed at the Harvard College Observatory, has included a study of several variable stars of the Algol type, for the purpose of determining accurate periods and the forms of their light curves. It is desired by the association to establish a permanent fellowship yielding annually 100*l*., which will enable recent graduates of women's colleges to devote themselves for a year or more to advanced work in astronomy. A portion of the year may be spent at the Maria Mitchell Observatory and a part at Harvard College Observatory. It is hoped that one or more of these fellowships may be established by some former pupil of Miss Mitchell, open to graduates of Vassar, and that similar fellowships may be endowed for graduates of other colleges.

A report on the teaching of mathematics in Australia, by Prof. H. S. Carslaw, presented to the International Commission on the Teaching of Mathematics, has just been published (Sydney: Angus and Robertson; London: Oxford University Press). The problem of mathematical teaching stands in much the same position now in Australia as it stood at home a few years ago. Reformers are struggling to improve school teaching, and they find the chief obstacle to be the external examination held by a body with a limited knowledge of the schools. New South Wales has cut the knot by deciding to substitute examinations by its own Department of Public Instruction, and Queensland and Tasmania are following suit. It is a pleasing sign that some of the examining bodies are acting on the Mathematical Association reports on teaching. The decision of the Mathematical Association Committee that the congruence theorems and the condition of parallelism should be taken as the axiomatic basis of logical geometry was not available when Prof. Carslaw's report was written, and we read that the Board of Education Circular 711 advocating much the same treatment is condemned by the New South Wales education authority. It is permissible to hope that this authority, which is the most open-minded in Australia, and has a high regard for the Mathematical Association, may by this last decision of the association be induced to reconsider its condemnation.

SOCIETIES AND ACADEMIES.

London.

Linnean Society, June 4.—Prof E. B. Poulton, president, in the chair.—Rev. G. **Henslow**: Darwin's alternative explanation of the origin of species, *without* the means of Natural Selection.—G. C. **Robson**: On a collection of land and freshwater gastropods from Madagascar, with descriptions of a new genus and new species. The affinities of the species examined were found to be mainly Oriental and not African.—Prof. H. H. W. **Pearson**: Notes on the morphology of certain structures concerned in reproduction in the genus Gnetum. This is an account of an investigation of (1) androgynous and pseudoandrogynous spikes of *Gnetum gnemon*; (2) the young embryosac of *G. africanum*.—Prof. C. **Chilton**: Deto, a subantarctic genus of terrestrial crustacea. Deto is a genus of terrestrial isopoda, established in 1837 by Guérin for the species *D. echinata* from the Cape of Good Hope. The genus shows a typical subantarctic distribution and emphasises the close connection between the faunas of New Zealand and South America.

Cambridge.

Philosophical Society, May 18.—Dr. Shipley, president, in the chair.—Prof. **Pope** and J. **Read**: Optically active substances of simple molecular constitution. Notwithstanding numerous attempts, it has not hitherto been possible to prepare an optically active substance containing fewer than three carbon atoms in the molecule, and the assumption has therefore been made that a considerable degree of complexity is necessary to enable the molecule to exist in stable enantiomorphous forms. After unsuccessful attempts to resolve chlorosulphoacetic acid and chlorobromomethanesulphonic acid the preparation and investigation of chloroiodomethanesulphonic acid were undertaken with a similar object in view, and eventually the resolution of this substance was effected with *d*- and *l*-hydroxyhydrindamine, strychnine and brucine. The purest optically active ammonium salt of this acid yet obtained, having $[M]_{5461}+43{\cdot}7^{\circ}$ in dilute aqueous solution, was prepared by repeated fractional precipitation with brucine, followed by decomposition of the brucine salt with ammonia; but the separation of the substance in a state of optical purity presents great difficulty. It is remarkable that the optically active ammonium salt, which, containing only one carbon atom in the molecule corresponding to less than 5 per cent. of carbon, is the simplest optically active substance known, retains its activity with great persistence, and cannot be caused to racemise by any of the ordinary agents employed for that purpose.—Dr. **Fenton**: Note on the detection of malonic acid.—F. E. E. **Lamplough** and J. T. **Scott**: Some further experiments on eutectic growth. The method of "quenching" an alloy during the solidification of the eutectic has been used to ascertain the character of the eutectic during its growth. Resulting from the investigation it has been possible to classify eutectics into two classes: (1) those of spherical radiating growth, (2) those exhibiting definite crystal contours. The former are always produced when both primaries are of rounded contour, the latter if one primary is of crystal shape. The cause of "halos" surrounding primary crystals has been demonstrated.—W. H. **Mills**, H. V. **Parker**, and R. W. **Prowse**: The resolution of 5-nitrohydrindene-2-carboxylic acid. With the object of obtaining an optically active derivative of benzene in which to account for the optical activity it would be necessary to take into consideration the relative distribution in space of the groups attached to the benzene nucleus 5-nitrohydrindene-2-carboxylic acid (III) has been prepared, and has been shown to be resolvable into two optically active components.—R. D. **Kleeman**: (1) The nature of the internal work done during the evaporation of a liquid. (2) The work done in the formation of a surface transition layer of a liquid mixture of substances.—N. **Wiener**: A contribution to the theory of relative position.

EDINBURGH.

Royal Society, May 4.—Prof. James Geikie, president, in the chair.—Dr. D. M. Y. **Sommerville**: Description and exhibition of a four-dimensional model. The analogue of the icosahedron in three-dimensional space is the four-dimensional figure bounded by six hundred regular tetrahedra. The model showed a projection of this figure in three dimensions, one vertex being used as the centre of projection. The model showed the successive zones of vertices which surround any vertex.—Dr. C. G. **Knott**: Changes of electrical resistance accompanying longitudinal and transverse magnetisation in iron and steel. The experiments established for iron and steel results very similar to those previously obtained with nickel. Thin ribbons about 2 cm. wide were used. It was found that the increase of resistance under a given longitudinal field was diminished when this longitudinal field was superposed upon a steadily maintained transverse field. In high transverse fields the increase due to the superposed longitudinal field was barely measurable; but in no case did the change become a decrease, as was noticed in the case of nickel. Again, the diminution of resistance due to the action of a transverse field became markedly increased when the transverse field was superposed upon a steadily maintained transverse. This curious result had also been obtained with nickel.—Dr. R. **Campbell**: Rocks from Gough Island, South Atlantic (Scottish National Antarctic Expedition). The specimens, which were collected by Dr. J. H. Harvey Pirie, were, with the exception of a small piece of limestone, all igneous, being mainly soda trachytes, trachydolerites, basalts, an essexite, and tuffs. The collection showed that the rocks of Gough Island had all been derived from a soda-rich alkali magma, and that in all probability they had had a common origin with the rocks of the other volcanic islands in the Mid-Atlantic.

May 25.—Dr. B. N. Peach, vice-president, in the chair.—A. D. **Darbishire** and M. W. **Gray**: The inheritance of certain characters of the wool of sheep. The results, which dealt chiefly with thickness of fibre, were obtained with two crosses: (1) between the Southdown and the wild sheep of the island of Soay, (2) between the Southdown and the black-face. With regard to thickness of fibre, Southdown was almost completely dominant over the Soay sheep; and in the second case the cross with the Southdown had the effect of entirely cutting out the long coarse fibres of the black-face fleece. The mean character of the first-cross wool was almost exactly intermediate between those of the two parents of the cross.—Dr. J. H. **Ashworth**: A new species of Sclerocheilus, with a revision of the genus. There were only two known valid species, *S. minutus*, Grube, and *S. antarcticus*, the latter a new species represented by two specimens, one obtained by the Scottish National Antarctic Expedition at the South Orkneys, the other (*Eumenia oculata*, Gravier) by the second French Antarctic Expedition at Petermann Island, Graham Land. The external features of both species were described and figured, and the diagnosis of the genus amended. *S. minutus* was recorded for the first time from Ireland, Blacksod Bay and Clew Bay, co. Mayo.

PARIS.

Academy of Sciences, June 8.—M. P. Appell in the chair.—G. **Humbert** and Paul **Lévy**: Singular Abelian functions of three variables.—A. **Haller** and R. **Cornubert**: Syntheses by means of sodium amide. Derivatives of β-methyl*cyclo*pentanone. The preliminary introduction of an α-methyl group is necessary, before sodium amide can be usefully employed for further methylation. The final product is $\alpha\alpha\beta\alpha'\alpha'$-pentamethyl*cyclo*pentanone.—Charles **Moureu** and Georges **Mignonac**: The diagnosis of the primary, secondary, and tertiary bases. An ethereal solution of ethylmagnesium bromide serves as a reagent; secondary and primary bases giving off a molecule of ethane for each replaceable hydrogen molecule, whilst tertiary bases give no gas evolution.—Amand **Gautier** and Paul **Clausmann**: Fluorine in mineral waters. Fluorine is present in all mineral waters, hot or cold, in amounts ranging from 0·3 to 6·3 milligrams per litre. Waters of volcanic origin contain the largest proportion of fluorides.—André **Blondel**: The harmonic analysis of alternating currents by resonance.—A. **Lacroix** was elected perpetual secretary for the physical sciences in the place of the late Ph. van Tieghem.—M. **Coggia**: Observation of the comet 1914*b* (Zlatinsky) made at the Observatory of Marseilles. Position given for May 28.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1914.—Alex. **Véronnet**: Some causes explaining the heat of the sun. The hypotheses regarding the source of the sun's heat—chemical action, radio-activity, attraction of meteorites—are critically examined and shown to be insufficient. The Helmholtz theory of the heat being due to the work of contraction is shown to be best in accord with facts, although even this view gives a shorter life for the sun than is required by geology.—Maurice **Gevrey**: The analytical properties of the solutions of partial differential equations.—Richard **Suppantschitsch**: A development in series of the powers of a polynomial.—Frédéric **Riesz**: Trigonometrical polynomials.—Serge **Bernstein**: The absolute convergence of trigonometrical series.—T. H. **Gronwall**: Some methods of summation and their application to Fourier's series.—B. **Bouliguine**: A property of the

Riemann function $\xi(t)$.—F. La **Porte**: The compensation of a quadrilateral.—H. **Pelabon**: Thermo-electric study of selenium-antimony mixtures. The existence of the definite compound Sb_2Se_3 was proved by these measurements.—Paul **Pascal**: Uranyl sulphocyanide.—R. **Marcelin**: The exchange of material between a liquid or a solid and its saturated vapour.—Maurice **Curie**: The deviations of atomic weights obtained with lead arising from different minerals. The atomic weight of lead derived from uranium minerals is lower and from monazite slightly higher than that of lead from galena. These results are in agreement with those predicted from the theory of radio-active transformations.—Philip E. **Browning**: The action of bromine on the hydroxides of lanthanum and didymium. These hydroxides, in suspension in dilute alkali solutions, dissolve in bromine with unequal velocities, the solution of the lanthanum being more rapid. A description is given of the application of this fact to a new and rapid method of separation of these two metals.—Edouard **Bauer**: The action of sodium amide upon some 1 : 5-diketones. Study of products of the reaction between sodium amide and the two ketones, benzaldiacetophenone and dibenzoyl-1 : 3-propane.—Milivoye **Losanitch**: The susceptibility of the ethylene lactones for fixing sodium derivatives of methylene compounds.—E. E. **Blaise**: The hydroxylamine derivatives of 1 : 4-diketones and N-oxy-2 : 5-dimethylpyrrol. The reaction between hydroxylamine and diacetylsuccinic ester is not comparable with that of the same reagent and 1 : 4 diketones. In the latter case only mono- and di-oximes are formed.—G. **Courtois**: Uranyl glycolate, and lactate and some uranyl salts of the polyacids of the fatty series.—Charles **Dufraisse**: The two stereoisomeric forms of benzoylphenylacetylene dibromide. The two isomers have been isolated, one of which is coloured and the other colourless.—Mlle. H. Van **Risseghem**: β-Pentene and some of its derivatives.—G. **Chavanne**: The ethylene isomerism of the α-bromopropenes.—Mme. E. **Bloch**: The modifications produced in the structure of roots and stems by an external compression. In all plants grown under compression there is an abundant liquefication of the medullary parenchyma.—F. **Gérard**: Three new species of Chlænaceæ.—P. **Hariot**: Two new Chytridiaceæ.—J. **Tissot**: The mechanism of the inactivation of sera by dialysis. The conditions governing the dissociation of the soaps in the serum.—H. **Violle**: The pathogeny of cholera. The cholera bacillus only develops in a limited zone of the intestine, and only then if this zone is free from all biliary secretion. The liver is thus one of the natural defences of the body against cholera.—Th. **Nogier** and Cl. **Regaud**: The decrease in the radio-sensibility of malignant tumours treated with successive doses of X-rays. Auto-immunisation against X-rays.—M. **Lécaillon**: The phenomena of natural rudimentary parthenogenesis produced in *Turtur risorius*.—H. **Stassano** and M. **Gompel**: The considerable bactericidal power of mercuric iodide. Mercuric iodide has much greater power in killing bacteria than either mercuric cyanide, benzoate, or chloride. It is ten times as active as corrosive sublimate.—A. **Fernbach** and M. **Schoen**: New observations on the production of pyruvic acid by yeast.—Jean **Groth**: The Sierra Morena.—M. **Dalloni**: The tectonic of the Catalan Pyrenees and the supposed "nappe de Montsech."—Léon **Lutaud**: The raised beaches of the coast of Estérel.—Robert **César-Franck**: The relations between the geological constitution of the Isle of Wight and the form of its coast line.—Philippe **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint Genis Laval) during the first quarter of 1914.

BOOKS RECEIVED.

Meteorology in Mysore for 1912. By N. V. Iyengar. Pp. xi+56. (Bangalore: Government Press.)

Report on the Lepidoptera of the Smithsonian Biological Survey of the Panama Canal Zone. By H. G. Dyar. Pp. 139–350. (Washington: Government Printing Office.)

Report on the Progress of Agriculture in India for 1912–13. Pp. iii+69. (Calcutta: Government Printing Office.) 8 annas.

Department of Lands and Survey, Western Australia. Handbook for Surveyors and Draftsmen. Compiled by N. S. Bartlett. Pp. ii+110 and Appendices. (Perth, W.A.: F. W. Simpson.)

Mendels Vererbungstheorien. By W. Bateson. Translated by A. Winckler. Pp. x+375. (Leipzig and Berlin: B. G. Teubner.) 12 marks.

Pflanzenanatomie. By W. I. Palladin. Translated by Dr. S. Tschulok. Pp. iv+195. (Leipzig and Berlin: B. G. Teubner.) 4.40 marks.

The Social Guide. By Mrs. H. Adams and E. A. Browne. Pp. 264. (London: A. and C. Black.) 2*s.* 6*d.* net.

The Elements of Chemistry. By H. L. Bassett. Pp. xii+368. (London: Crosby Lockwood and Son.) 4*s.* 6*d.*

L'Harmonie Tourbillonnaire de l'Atome. By F. Butavand. Pp. 52. (Paris: Gauthier-Villars et Cie.) 2 francs.

Chemical Calculations. By H. W. Bausor. Pp. iv+136. (London: W. B. Clive.) 2*s.*

Chemical Calculations. (Advanced Course.) By H. W. Bausor. Pp. iv+48. (London: W. B. Clive.) 1*s.*

Fortschritte der Mineralogie, Kristallographie, und Petrographie. Edited by Prof. G. Linck. Vierter Band. Pp. iv+384. (Jena: G. Fischer.) 12 marks.

Lehrbuch der Biologie für Hochschulen. By M. Nussbaum, G. Karsten, and M. Weber. Zweite Auflage. Pp. viii+598. (Leipzig and Berlin: W. Engelmann.) 12 marks.

Hypnose und Katalepsie bei Tieren. By Prof. E. Mangold. Pp. 82. (Jena: G. Fischer.) 2.50 marks.

Die Mechanistischen Grundgesetze des Lebens. By A. Cohen-Kysper. Pp. viii+373. (Leipzig: A. Barth.) 7 marks.

Modern Substitutes for Traditional Christianity. By E. McClure. Second edition. Pp. viii+224. (London: S.P.C.K.) 2*s.* 6*d.* net.

Philosophy: What Is It? By Prof. J. B. Jevons. Pp. vii+135. (Cambridge: University Press.) 1*s.* 6*d.* net.

Know Your Own Mind. By W. Glover. Pp. ix+204. (Cambridge: University Press.) 2*s.* net.

Bacon's Large-scale Map of Australia. In four sheets mounted on cloth to fold in cloth case. (London: G. W. Bacon and Co., Ltd.) 25*s.*

Psychopathology of Everyday Life. By Prof. S. Freud. Authorised English edition, with Introduction. By Dr. A. A. Brill. Pp. vii+342. (London: T. Fisher Unwin.) 12*s.* 6*d.* net.

The Pursuit of Natural Knowledge. By Prof. J. R. Ainsworth-Davis. Pp. iv+284. (Cheltenham: Norman, Sawyer and Co., Ltd.) 1*s.* net.

Minerals and the Microscope. By H. G. Smith. Pp. xi+116. (London: T. Murby and Co.) 3*s.* 6*d.* net.

The History and Theory of Vitalism. By Prof. H. Driesch. Translated by C. K. Ogden. Pp. viii+239. (London: Macmillan and Co., Ltd.) 5*s.* net.

The Thinking Hand: or Practical Education in the Elementary School. By J. G. Legge. Pp. x+217. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Memorials of Henry Forbes Julian. Written and edited by his Wife, Hester Julian. Pp. xix+310. (London: C. Griffin and Co., Ltd.) 6*s.* net.

Alcoholic Fermentation. By Dr. A. Harden. Second edition. Pp. vii+156. (London: Longmans and Co.) 4*s.* net.

Memoirs of the Department of Agriculture in India. Entomological Series. Vol. v., No. 1., Life-histories of Indian Insects; v., Lepidoptera (Butterflies). By C. C. Ghosh. Pp. iv+72+ix plates. (Pusa: Agricultural Research Institute.) 3*s.* 9*d.*

The Natural History of the Farm. By Prof. J. G. Needham. Pp. 348. (Ithaca, N.Y.: Comstock Publishing Co.) 1.50 dollars.

Edinburgh and East of Scotland College of Agriculture. Investigation into the Disease of Sheep called "Scrapie" (Traberkrankheit; La Tremblante), by Dr. J. P. M'Gowan. Pp. ix+116. (Edinburgh: W. Blackwood and Sons.)

Cambridge Manuals of Science and Literature: The Making of Leather. By H. R. Procter. Pp. x+153. The Sun, by Dr. R. A. Sampson. Pp. viii+141. Coal Mining. By T. C. Cantrill. Pp. viii+159. (Cambridge University Press.) 1*s.* net each.

Lehrbuch der Meteorologie. By Prof. J. Hann. Dritte Auflage. Lief. 4, 5, 6, 7. Pp. 289–640. (Leipzig: C. H. Tauchnitz.) 3.60 marks each.

The Oxford Survey of the British Empire. Edited by Prof. A. J. Herbertson and O. J. R. Howarth. The British Isles and Mediterranean Possessions. Pp. xii+596+7 maps. Asia, including the Indian Empire and Dependencies, Ceylon, British Malaya, and Far Eastern Possessions. Pp. x+505+5 maps. Africa, including South Africa, Rhodesia, Nyasaland, British East Africa, Uganda, Somaliland, Anglo-Egyptian Sudan and Egypt, etc. Pp. xvi+547+5 maps. America, including Canada, Newfoundland, the British West Indies, and the Falkland Islands and Dependencies. Pp. x+511+6 maps. Australasia, including Australia, New Zealand, the Western Pacific, and the British Sector in Antarctica. Pp. xii+584. General Survey, including Administration, Legal Problems, History, Defence, Education, Acclimatisation, Mapping, Commerce, Communication, Migration. Pp. viii+386+1 map. (Oxford: Clarendon Press.) 14*s.* net each.

DIARY OF SOCIETIES.

THURSDAY, JUNE 18.

ROYAL SOCIETY, at 4.30.—(1) Trypanosome Diseases of Domestic Animals in Nyasaland. *Trypanosoma Caprae*, Kleine. III: Development in *Glossina morsitans*; (2) Trypanosomes found in Wild *Glossina morsitans* and Wild Game in the "Fly-Belt" of the Upper Shire Valley; (3) The Food of *Glossina morsitans*; (4) Infectivity of *Glossina morsitans* in Nyasaland during 1912 and 1913: Sir D. Bruce, Maj. A. E. Hamerton, Capt. D. P. Watson and Lady Bruce.—A Description of the Skull and Skeleton of a Peculiarly Modified Rupicaprine Antelope *Myotragus balearicus*, Bate: Dr. C. W. Andrews.—The Relation between the Thymus and the Generative Organs, and on the Influence of these Organs upon Growth (With a Note by G. U. Yule): E. T. Halnan and F. H. A. Marshall.—The Vapour Pressure Hypothesis of Contraction of Striated Muscle: H. E. Roaf.—The Validity of the Microchemical Test for the Oxygen Place in Tissues: A. N. Drury.—Man's Mechanical Efficiency: Prof. J. S. Macdonald.—The Colouring Matters in the Compound Ascidian *Diazona violacea*, Savigny: Dr. A. Holt.—Some Accessory Factors in Plant Growth and Nutrition: Prof. W. B. Bottomley.—A Photographic Analysis of Explosion-flames Traversing a Magnetic Field: Prof. H. B. Dixon, C. Campbell, and W. E. Slater.

LINNEAN SOCIETY, at 8.—Reports on the Marine Biology of the Sudanese Red Sea: The Brachyura: R. Douglas Laurie.—A Revision of the Recent Colonial Astræidæ Possessing Distinct Coralites: G. Matthai.—Two Lichens: *Lecanora isidioides*, Nyl., from the New Forest; and *Parmelia revoluta* var *concentrica*, Cromb., from Seaford Downs: R. Paulson.—Ecological Notes, chiefly Cryptogamia; the late W. West.—Life-histories and Descriptions of Australian Æschinæ. (With a Description of a New Form of Telephebia by H. Campion): R. J. Tillyard.—The Life-history and Structure of *Telephorus lituratus*: Miss Olga G. M. Payne. Cucujidæ, Cryptophagidæ, avec une Description de la larve et de la nymphe de *Protominia convexiuscula*, Grouvelle: A. Grouvelle.—Mallophaga, Aphaniptera, and Diptera Puparia. (Percy Sladen Expedition): H. Scott.—Short Cuts to Nectaries by Blue Tits: C. F. M. Swynnerton.—Photographs of Large-tailed Sheep of the Punjab: Dr. G. Henderson.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Final Report on the Rivers Investigation: Dr. A. Strahan and Others.

MONDAY, JUNE 22.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in the Unknown Brahmaputra Region on the North-Eastern Frontier of India: Captain F. M. Bailey.

VICTORIA INSTITUTE, at 4.30.—Annual Address: Jerusalem, Past and Present: Sir C. M. Watson.

WEDNESDAY, JUNE 24.

GEOLOGICAL SOCIETY, at 8.—The Trilobite Fauna of the Abbey Shales, near Hartshill: V. C. Illing.—Notes on the Trilobite Fauna of the Middle Cambrian of the St. Tudwal's Peninsula (Carnarvonshire): T. C. Nicholas.

THURSDAY, JUNE 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Note on Mr. Mallock's Observations on Intermittent Vision: Prof. S. P. Thompson.—The Variation of Electrical Potential across a Semipermeable Membrane: Prof. F. G. Donnan and G. M. Green.—The Potential of Ellipsoidal Bodies and the Figures of Equilibrium of Rotating Liquid Masses: J. H. Jeans.—The Twenty-seven-Day Period in Magnetic Phenomena: Dr. C. Chree.—Electrification of Water by Splashing and Spraying: J. J. Nolan.—Attempts to Produce the Rare Gases by Electric Discharge: T. R. Merton.—The Analysis of Gases after Passage of Electric Discharges: O. C. G. Egerton.—*And other Papers.*

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THURSDAY, JUNE 25, 1914.

MATHEMATICS AND CIVILISATION.

Die Kultur der Gegenwart. Edited by P. Hinneberg. *Die Mathematischen Wissenschaften,* unter Leitung von F. Klein. Part iii., section i. Fascicles i., ii. (i. H. G. Zeuthen: *Die Mathematik im Alterthum u. im Mittelalter*; ii., A. Voss: *Die Beziehungen d. Mathematik zur Kultur d. Gegenwart,* and H. E. Timerding: *Die Verbreitung mathematischen Wissens u. math. Auffassung.* Berlin and Leipzig: B. G. Teubner, 1912–14.) Price 3 marks each.

THESE three monographs are agreeably different, as well as complementary; and even where they overlap, the variety of treatment is interesting. The first section is the most detailed and (comparatively) technical; its author, as might be expected, gives an excellent and well-balanced account of Greek and medieval European mathematics. Something more might have been said about the earlier Indian inventions; only a very brief paragraph is devoted to China, and apparently nothing is said about Japan.

Mr. Voss's article is extremely interesting and well-arranged. He shows how mathematics have influenced, and been influenced by, technical crafts, physical theories, and philosophy; and he has the courage to make high, but legitimate, claims for a science which seems to be as unpopular in Germany as it is with us. He points out that mathematics is pre-eminently a creation of the spirit of man; that it is his least restricted field of activity; and that we are under a moral obligation to cultivate it. It is very refreshing to find these truths stated with such decision and clearness; and no one who is convinced of them should neglect a seasonable opportunity of repeating them. The popular attitude towards mathematics is exceptionally unfair. The ordinary man does not despise a physician, or a judge, or a divine, because he himself is ignorant of medicine, or law, or theology; but it is very rarely that he regards mathematics as anything more than a set of rules for calculation, or mathematicians more than computers at best, and at worst harmless cranks who waste their time on puzzles, quite useless to the practical man. The most exasperating folk of all are those who have to use mathematical formulæ for technical purposes, and adopt towards the science which serves them, while they do not understand it, a sort of silly, patronising attitude, such as that of a good-natured merchant to one of his junior clerks.

To put the main argument in a form which may appeal to a man of common sense, we affirm, without fear of refutation, that the history of culture is a history of intellectual development, in which the main feature is a change of habits of thought; instead of vague fancies, irrational dogmas, crude superstitions, we are gradually acquiring clear concepts, consistent theories, and some sort of ethics worthy of the name. Towards this wholesome change nothing whatever has contributed so much as the study of pure mathematics; its inclusion, for instance, in a school curriculum is amply justified by its power of exposing intellectual dishonesty—what Smith minor calls "fudge"—to the practice of which we are all more inclined than we should like to admit.

To take an illustration of what we mean. In the second Book of Samuel (ch. xxiv.) it is stated that David's sin in numbering his people was punished by a heaven-sent pestilence which killed 70,000 men. Christians having adopted the Jewish Canon as an inspired document, the prejudice created by this story was so great that no Christian census was taken before 1700 A.D.; and no trustworthy census dates before the first year of the nineteenth century. Even now there are people who resent the census, and by making false entries do their best to make it untrustworthy; but there must be few who really think an act of simple enumeration sinful, and a good many who understand the value of the census for insurance purposes, at any rate.

The interest of Mr. Timerding's essay is of a more pedagogic kind. Among other interesting things we may note the references to Jacobi, his mode of teaching, and views about intuition (pp. 128–30); "blackboard physics" (p. 137); and especially the account of recent changes in mathematical teaching in Germany. Near the end of the article the author makes a statement which (with due reservations) we are inclined to challenge. He maintains that in technical schools (*fachliche Schulen*) the aim of mathematical teaching is "entirely different" from what it is in the general schools; adding, in effect, that the attention of technical students should not be diverted from such applications of mathematics as they are likely to have to make. We believe, on the contrary (and not without experience), that technical students (such as engineers, or accountants, or draughtsmen), can be interested, rather more easily than ordinary students, in the principles of mathematics, by taking them in the right way. This, we believe, is by beginning with definite numerical examples of the kind they will meet with in their profession, and then proceeding, by an inductive method, to the general formulæ and theories which solve all such problems. In this way, an engineer becomes interested in electricity, or thermodynamics, as the case may be, an accountant in the theory of errors, a draughtsman in projective geometry. By adopting the opposite course a very great risk is run; that of stifling the speculative instinct of a really gifted pupil. Suppose Hertz or Heaviside or Helmholtz had been debarred from all but "technical" sources of information! No doubt the teacher will occasionally talk over the heads of half his class; but if he does not do this too often no great harm is done. And the chance of securing for humanity a real thinker is such a glorious one that nobody who understands the meaning of such a success will hesitate for a moment in advancing so far as he can, and so far as he dare, from the vulgarity of technique to the culture of theory. G. B. M.

PSYCHOLOGY AND CHILD HYGIENE.

(1) *Human Behaviour: a First Book in Psychology for Teachers.* By Prof. S. S. Colvin and Prof. W. C. Bagley. Pp. xvi+336. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 4s. 6d. net.

(2) *Inductive versus Deductive Methods of Teaching: an Experimental Research.* By W. H. Winch. Pp. 146. (Baltimore, U.S.A.: Warwick and York, Inc., 1913.) Price 1.25 dollars.

(3) *How I Kept My Baby Well.* By Anna G. Noyes. Pp. 193. (Baltimore, U.S.A.: Warwick and York, Inc., 1913.) Price 1.25 dollars.

(4) *Minds in Distress.* By Dr A. E. Bridger. Pp. xi+181. (London: Methuen and Co., Ltd., 1913.) Price 2s. 6d. net.

(1) IN their text-book on "Human Behaviour," Prof. Colvin and Prof. Bagley have endeavoured to formulate the main principles of psychology in terms of conduct. For the immature and inexperienced teacher they believe that a "functional" viewpoint is the more helpful. The topics they have selected are those most closely related to the practical work of the schoolroom. Memory, habit, instinct, feeling, emotion, attention, economical learning, higher thought-processes—these are discussed far more fully than is usual in teachers' text-books. The treatment is throughout concrete. Each principle is formulated with a lucidity that is almost dangerous; and enforced with a wealth of illustration that is almost too convincing—drawn as it is from classroom practice or from everyday life more often than from the psychological or educational laboratory. Experimental work is by no means ignored. But detailed references to it are rare in the text and rarer in the bibliography. The "immature and inexperienced teacher" might easily gain the impression that a few simple and uncontrolled observations, followed by many clear and plausible inferences, are the surest guide to final generalisations upon the most complex problems of human and animal behaviour. Of its class, however, this book is undoubtedly one of the best.

(2) Mr. Winch's book upon "Inductive versus Deductive Methods," is the second he has contributed to Professor Whipple's admirable series of Educational Psychology Monographs. It is a record of a series of experiments, carried out in five London schools, to test the relative value of the two methods in teaching. When tested upon new material, it was found that in all the schools the children taught inductively did better than those taught deductively. When tested upon the old material that formed the medium of what they had been taught, the children did differently in different cases. In three of the schools they did better when working by the "deductive and memoriter" method. In other cases, especially where the children were older, the inductive method proved equally successful; and there were indications that, when the test was applied after a long interval, it was even more successful. The subject-matter of the investigation was geometrical definition; and although laboratory and introspective controls were perhaps of necessity omitted, in other respects the work may well serve as a model for further investigations dealing with other subjects of the school curriculum.

(3) Like the Journal that he edits, Prof. Whipple's series of monographs proposes to include problems of child hygiene as well as child psychology. Mrs. Noyes' contribution is the story of how she kept her baby well during the first two years of its life. As a record of physical health during this period, and as a statement of the means used to maintain it, her work is more complete than any that has yet been published. Once more we are presented with an excellent model for future observations. With a number of records as thorough as this, we should at last have a sound basis for a scientific description of the physical development of young children.

(4) Dr. Bridger's treatment of his subject is of a different character. In his book "Minds in Distress" he maintains that the origin of functional nervous diseases depends upon two fundamental principles: first, "that mental comfort depends upon a state of balance between two main factors," namely, "common sense" and "new impressions"; secondly, "that there are the 'masculine' and the 'feminine' types." Loss of balance in the "masculine" type results in such disorders as neurasthenia; loss of balance in the "feminine" type, in such disorders as hysteria. In a chapter on "Mental Formulæ" he gives, in quantitative

and tabular form, the composition of the mind in the various cases. Thus, in the "normal average masculine type of mind" we learn that 30 per cent. of the mental energy is distributed to "ideas relating to self," 15 per cent. to "ideas relating to others," and so on; in the "normal average feminine type of mind" the percentages are 20 and 5 respectively. His "elementary formulæ" Dr. Bridger admits are somewhat inexact. But his two fundamental propositions he believes to be "principles that are of universal acceptance, free of speculative theory, and reducible to the simplest terms." His proof throughout is "an appeal. . . to the common experience of humanity." The generalisations of James, Titchener and Wundt he dismisses on the first page as too metaphysical; and, for the rest, he does not refer to well-known writers on the subject, because, as he rightly says, "they all approach it from an entirely different point of view." CYRIL BURT.

RECENT BOTANICAL WORKS.

(1) *Paléontologie végétale. Cryptogames cellulaires et Cryptogames vasculaires.* By Dr. F. Pelourde. Pp. xxviii+360. (Paris: O. Doin et Fils, 1914.) Price 5 francs.

(2) *Die Oekologie der Pflanzen.* By Dr. Oscar Drude. Pp. x+308. (Braunschweig: F. Vieweg and Son, 1913.) Price 10 marks.

(3) *The Diseases of Tropical Plants.* By Prof. M. T. Cook. Pp. xi+317. (London: Macmillan and Co., Ltd., 1913.) Price 8*s*. 6*d*. net.

(4) *Icones Orchidearum Austro-Africanarum Extra-Tropicarum; or, Figures, with Descriptions of Extra-Tropical South African Orchids* By Harry Bolus. Vol. iii. 100 plates. (London: W. Wesley and Son, 1913.) Price 30*s*. net.

(5) *Index Kewensis. Plantarum Phanerogamarum. Supplementum Quartum.* (1906–1910.) Ductu et Consilio D. Prain. Pp. 252. (Oxford: Clarendon Press, 1913.) Price 36*s*. net.

(1) DR. FERNAND PELOURDE, préparateur at the National Museum of Natural History, is publishing, under the auspices of the Encyclopédie Scientifique, an account of palæobotany in accordance with present knowledge. In this, the first volume, he deals with cellular and vascular cryptogams; in two subsequent volumes he will deal with gymnosperms and angiosperms, and will also formulate general conclusions from botanical and geological points of view. M. R. Zeiller, to whom the volume is dedicated, has written the preface. The text comprises a short introduction on the methods of preservation of fossil plants and a classified list of geological strata. The great plant-groups are then studied in order beginning with bacteriaceæ, including reference to their work in formation of coal. The chapter on the cellular cryptogams occupies only twenty-two pages, but the reader is referred to numerous papers dealing especially with fossil algæ. The groups of vascular cryptogams are considered in the following order: equisetales, sphenophyllales, lycopodiales, filicales. The little volume, which presupposes some knowledge of general botany, especially anatomy, gives a somewhat condensed review of the subject, but will enable the student of botany to form an idea of the present position of our knowledge of the groups considered so far as concerns extinct forms. A useful feature is the bibliography which follows the subject matter.

(2) Dr. Oscar Drude's handbook on the ecology of plants forms one of the "Die Wissenschaft" series of volumes on natural science and technique. In 1904 Dr. Drude was invited to lecture before the International Science Congress at St. Louis on the development and position in modern science of botanical ecology and the present volume is an outcome of the work done in that connection. The subject is considered under four headings. Section I. is entitled "Die physiognomischen Lebensformen der Pflanzen." The author first gives a historical review of the attempts to classify plants according to their "physiognomic"—a term originated by Humboldt—relations, that is to say, their general structure and manner of growth as determined by the external conditions to which they are subjected. After discussing the principles underlying such a system, he proposes a system of classification of plants based on their habit. Vascular plants are arranged in two great groups: I. Aerophytes, and II. Hydrophiles and Hydrophytes. The former includes thirty-eight classes, beginning with (1) monocotyledonous "Schopfbäume"—the palm, pandanus, and xanthorrhœa type, embodying a pillar-like stem bearing a crown of leaves followed by (2) palm-bush type and palm lianes, (3) short-stemmed dwarf palms, (4) tree-ferns and cycads, (5) conifer-type, followed by the various types of dicotyledonous woody plants, climbers, epiphytes, perennial and short-lived herbaceous types, etc., concluding with saprophytes and parasites. Waterplants include six classes and cellular plants twelve.

Section II., entitled climatic influences, periodicity, and leaf-character, deals with nutrition as a function of the leaf, and periodicity in plant-life as an adaptation to climatic phases. Section III., "Physiographic Ecology," discusses briefly various factors which determine the formation of plant-communities and associations, with a classification of types of vegetation as ultimate physiographical units. Section IV., "Ecological epharmosis and phylogeny," includes a brief discussion of the relation or absence of relation between plant-habitat and natural relationships, eurychory and stenochory, the behaviour of nearly-allied species in the fight for space, and similar questions, with finally a short discussion on mutation of species and evolution. Explanatory notes and a bibliography are appended to the first section, and also in the form of a general appendix at the end of the book, and the eighty block illustrations form a helpful addition to the text-matter.

(3) The purpose of Dr. Cook's work is to direct attention to some of the most common and most destructive diseases of tropical plants; to give as practical a knowledge as possible of plant diseases in general and their causes; and to give the most common remedies and methods of prevention. Since the eastern and western tropics have each their own peculiar problems, the writer notes that his own experiences have been restricted entirely to the American tropics. The first chapter deals with the nature and symptoms of diseases; the second contains a very brief account of the general structure of a seed-plant, and of fungi as sources of disease, and their modes of reproduction. Chapter III. is a classified account of the fungi which cause plant disease; in chapter iv. other causes of plant diseases are briefly considered, whether due to plant- or animal-organisms or physical environment. These chapters are brief and admittedly very general. The most important part of the book is a description of the diseases which attack the various plants cultivated in the tropics, with suggestions for prevention or cure. The book closes with two short general chapters on prevention and control of disease and fungicides and spraying apparatus, followed by a useful classified bibliography.

(4) The third volume of the late Dr. Bolus's figures and descriptions of South African orchids has the appearance of a posthumous work. The nature of the authorship is explained in the preface by Mrs. H. M. L. Bolus who, as Miss Kensit, was intimately associated with Dr. Bolus in his botanical work; but for bibliographical purposes her share in the work might appropriately have been indicated on the title-page. The volume represents the fulfilment in part of a trust bequeathed by the author of the previous volumes. Of the hundred plates, thirty-six have already appeared in the "Orchids of the Cape Peninsula," now out of print, nine have been drawn by Mr. F. Bolus, and the remaining fifty-five are from finished or incomplete drawings by Dr. Bolus; in the latter case, additions having been made by his son, Mr. F. Bolus. The form of the book is uniform with that of previous volumes; the descriptions are in both Latin and English, and the plates include full and clear analyses of the flowers with careful indications of the colour of the parts. The announcement that Mr. and Mrs. Bolus propose to proceed with the illustration of African orchids is a most welcome one.

(5) It is not extravagant praise to say that no botanical publication is more eagerly expected, or more keenly welcomed on its appearance, than the five-yearly supplement of the *Index Kewensis*. The working systematist has now ready to hand a record of the names of the genera and species of flowering plants from the initiation of the binominal system in 1753 to the end of 1910, a record which only those who remember the time when there was no Kew Index can fully appreciate. The present supplement marks a great improvement on the earlier-issued portions of the work in that the date of publication has been added to the citations. We note also a considerable number of references to species which have previously been overlooked. New combinations as distinguished from newly described species are indicated by reference to the earlier name. Further, the names indexed are all in the same type; presumed synonyms are not printed in italics: the book admirably fulfils its obligations as an index, but botanical discrimination is properly left to the worker. In view of the periodical appearance of supplements the question naturally arises as to the intercalation of the supplements with the original work; a question which must, without doubt, have occurred to those responsible for the compilation. But it is also matter for consideration whether the onus of such a work and its continuation indefinitely—a work of such supreme importance to the whole botanical world—should be the unaided task of the Director of Kew and his willing staff. A. B. R.

OUR BOOKSHELF.

The Childhood of the World. A Simple Account of Man's Origin and Early History. By E. Clodd. New edition, re-written and enlarged. Pp. xiii+240. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 4*s*. 6*d*. net.

A BOOK which has maintained a large and uninterrupted circulation for forty-one years, which has been printed in Braille character for the use of the blind, and translated into Dutch, French, German, Italian, Sekwana, and Swedish, well deserves the honour of a revised edition.

It falls into three parts: "Man the Worker," a record of the origin and life of early man; "Man the Thinker," describing the evolution of his religious belief; "Man the Discoverer and Inventor," treating of the progress of science. The treatment is essentially popular, and the wide knowledge of the writer, his pleasant style, and his skill in weaving into the narrative a store of interesting allusion and anecdote, render it an admirable introduction to the study of anthropology in its varied aspects. A series of well-selected illustrations, including the recently discovered frescoes in the French caves, with a useful bibliography, adds to its interest and value.

The present revision of the book is, on the whole, satisfactory. Detailed discussion of the complex problems of the past and future of man cannot be expected in a manual. But when mention is made of "the most ape-like" Piltdown skull, we might have anticipated at least a reference to the discoveries at Galley Hill and Ipswich. Some of the derivations, like those of "ship" and "gold" might be improved from Sir J. Murray's Dictionary. If he supposes that the modern Naga tribe in India are, like their forerunners of the same name, serpent worshippers, he is mistaken; and the taboo on the use of dry wood as fuel does not extend to the people of Berar, but to a single sacred grove. A curious press error gives the name of the Hindu sun-god Surya as "Sueya."

On the whole, this veteran anthropologist is to be congratulated on a book which, in its revised form, is certain to secure a new lease of popularity.

The School and College Atlas. One hundred and three maps, physical, political and commercial. Index. (London: G. W. Bacon and Co., Ltd., n.d.) Price 3*s.* 6*d.* net.

THIS Atlas is curiously unequal, for it contains a mixture of old style and new style maps; some maps are overcrowded with names, others are of striking simplicity. The summary maps dealing with temperatures are in some cases much too complicated. The colour-printed maps, showing relief on the layer system, indicate by the defective fit of the contours how difficult such cartographic work really is. For an atlas of this size the index is much too small.

The vegetation, annual and seasonal rainfall maps should prove of value, and the isotherms for the British Isles are based on actual temperatures and embody the latest official figures of the Meteorological Office. B. C. W.

The British Revolution. By Dr. R. A. P. Hill. Pp. xii+116. (Cambridge: University Press, 1914.) Price 2*s.* net.

THE most striking feature of most political discussions is, Dr. Hill considers, an entire lack of first principles, and he proceeds to enunciate a "synthetic" principle," which he claims stands alone in uniting individualism and socialism, home rule and imperialism, actuality and the ideal, and many other opposed views. He also remarks that one of his objects is to supplant Herbert Spencer's synthetic philosophy, or rather to supplement it by the principles of the German school.

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.*]

Dynamical Units for Meteorology.

IN the current number of the Quarterly Journal of the Royal Meteorological Society I have put forward a proposal for a name for a unit of acceleration, and shown how the introduction of such a unit leads up to the unit of potential which is required in the discussion of certain problems in aerodynamics. It has been suggested to me that as the proposal does not concern meteorologists alone it should be canvassed in a journal which is read by other physicists. I have written the following notes in the hope that you will be able to find room for them in NATURE.

The convenience of special names for such units as the *radian*, the *erg*, and the *volt*, is universally admitted. No apology is therefore needed for bringing forward a proposal for the adoption of a special name for a unit of acceleration. The particular unit for which a name is, I think, required is one decametre per second per second. This unit is slightly greater than the acceleration due to gravity at any point on the earth's surface, but so slightly that there is no difficulty in getting a clear conception of it. In this way it compares favourably with such units as one centimetre per second per second, or one foot per second per second. In accordance with the custom of honouring the pioneers of science by attaching their names to the units which occur in the branches which they discovered, it would be natural to name the unit of acceleration after Galileo. Unfortunately so long a name could not be used in forming compound names; I propose, however, to preserve the association of ideas by calling the unit a "leo." Accordingly I define the *leo* as the acceleration one decametre per second per second.

The acceleration of a falling body due to gravity and the earth's rotation is less than one leo by about 2 per cent.; the magnitude of the acceleration for various latitudes is shown in terms of the leo in the following table:—

Acceleration at the equator	...	0·9780 leo.
,, in latitude 45°	...	0·9806 leo.
,, at London ...	...	0·9812 leo.
,, at the poles	...	0·9832 leo.

Smaller accelerations may be expressed in terms of the same unit or in terms of smaller derived units; thus a vehicle which attains a velocity of 10 metres per second in 10 seconds from rest has an average acceleration 0·1 leo or 1 decileo. The unit of the c.g.s. system, 1 cm./sec.^{2} is, of course, identical with the millileo.

Turning to units of *force*, we find it natural to call the force which gives an acceleration of one leo to the mass one gram, a *leogram*. The leogram is identical with the kilodyne, but the new name makes the unit easier to realise, as it is seen to be slightly greater than the weight of one gram. In the same way the names, leokilogram and leoton, speak for themselves much better than megadyne and kilomegadyne.

For *pressure*, units with simple names, the bar and its sub-multiples exist already, but it is not very easy for meteorologists who have not devoted much attention to theoretical dynamics to realise the meaning of the standard definition 1 bar=1 megadyne per sq. cm. Perhaps the phrase 1 leokilogram per sq. cm. will be found easier to grasp. The millibar, which is the most convenient unit for stating barometric pressures, is 1 leogram per sq. cm. The c.g.s. unit of pressure is the microbar, which is equal to 1 leo-milligram per sq. cm.

Prof. McAdie, in the issue of NATURE of March 19, 1914, referred to the use by chemists of the word bar as a name for this c.g.s. unit of pressure. The bar of the chemist is the millionth part of the unit, mentioned in the last paragraph, which has been taken into use by Bjerknes and other meteorologists under that name. I do not wish to discuss here the merits of the question raised by Prof. McAdie. It is perhaps a matter for some international assembly attended by representatives of both chemistry and meteorology.

Coming now to units of work, we see that there is no difficulty in defining the leogrammetre as the work done by a leogram when its point of application moves through a metre. Names of this sort can be used in explaining the terms which are in use already for quantities of energy. Thus the leomilligramcentimetre is identical with the erg, the c.g.s. unit. The theoretical unit of electric energy, the joule, is 1 leo-kilogramdecimetre, whilst the commercial, or "Board of Trade" unit, defined as 1 kilowatthour, is 3600×1000 joules, or 360 leotonmetres.

Finally, we have to consider units of gravitational potential. The usual definition of potential is potential energy per unit of mass. The change of potential of 1 gram moved through one metre against a field of force sufficient to produce in it an acceleration one leo is one leogrammetre per gram, or briefly, one leometre. The difference in potential between two horizontal surfaces a metre apart depends on the latitude; it is 0·9780 leometre at the equator, and 0·9832 leometre at the poles.

The name leometre is proposed as an alternative to Prof. Bjerknes's "dynamic metre"; accordingly, it may not be out of place to conclude this letter by quoting the professor's note from the Quarterly Journal of the Royal Meteorological Society:—

"Names may be attacked from many points of view, and, even if left in peace during six years, they may be attacked in the seventh. Therefore a change in terminology contains a great risk. Still, I am willing to take the risk, if some guarantee can be obtained securing the prospects of the new terminology. I therefore take this opportunity to request everyone intending to attack the 'leometre' not to postpone the attack, but to execute it at once."

F. J. W. WHIPPLE.

Meteorological Office, South Kensington, S.W.

Aristotle's Physics.

THE review of Prof. Duhem's new book, "Le Système du Monde," over the initials, J. L. E. D., in NATURE of May 28, contains what purports to be a correct and intelligible summary of Aristotle's dynamics. It begins with the surprising words, "In his dynamics the idea of mass does not enter," and speaks loosely of motion as though Aristotle was treating of a varying velocity.

Sir George Greenhill and I both wrote to you on January 2, 1914 (vol xcii., p. 584), pointing out that Aristotle throughout treats only of the motion of projectiles, and of that only in a resisting medium, and then only of that part of the vertical motion when the projectile has attained that constant speed known to ballisticians as "terminal velocity," which can be as readily observed in rising smoke as in falling rain.

The equation on which Aristotle really bases his ballistics is:—

$$H = f\left(\frac{wg}{A\tau k}\right),$$

where H is the Newtonian terminal velocity, w is the weight of the projectile, A is the cross section of the projectile, τ is the density of the medium, k is the coefficient of shape.

In modern ballistic tables we write for the unit projectile:—

$$p = \frac{k}{g} v^n$$

Aristotle put n equal to unity.

We now know that there can be no simple equation for vertical motion in a resisting medium except by assuming that $n = 1$ or 2.

Whilst he was in England last week for the Roger Bacon celebrations at Oxford, I mentioned this subject to Father David Fleming, O.F.M. He gave me permission to say that during his tenure of the chair of philosophy at the Franciscan House of Studies in the University of Ghent, he taught the equation as I have given it as the obvious and only true meaning of Aristotle's own words. J. H. HARDCASTLE.

Phenomena of the Conscious and Unconscious.

NOT very long ago the province of psychology was supposed to be confined to the study of the phenomena of consciousness. Recently, however, its narrow limits have been allowed to be transcended; but even now the vast majority of psychologists is so exclusively occupied in inquiring into the effect of the conscious on the unconscious that scarcely any amount of justice has been done to the study of the influence of the unconscious on the conscious. Yet this latter inquiry is by no means insignificant. In fact, it counts for more and more. It is not merely that some actions, unconscious in the beginning, gradually become conscious through the constant interference of volition, and *vice versâ*. It is that the entire range of conscious activity is in essence reflex. The conscious, which is the superstructure of our mental life, has for its underground substratum the unconscious which moulds its shape and guides its course. Thus the conscious, which, superficially viewed, seems to control and modify reflexes is, in fact, itself a species of reflex.

The bare statement of this doctrine may look rather crude; but the grounds which substantiate it are rather of a speculative nature, and to dwell on them would not be quite appropriate in this journal. My aim, however, is different. I am not unaware of the rival theory which maintains that all human actions are essentially voluntary and have become reflex only by practice in the lifetime of the individual or of the race. What I desire by publishing this letter in NATURE is to elicit the opinions of physiologists as to the merits of the latter theory. To expect exact scientific evidence here is, of course, absurd. But are there even the remotest indications in the human and animal organism that favour this theory?

ABDUL MAJID.

Gola Gunj, Lucknow, India.

THE NATIONAL PHYSICAL LABORATORY IN 1913–14.

THE annual report of the National Physical Laboratory for 1913–14 was presented to the general board at the visitation day of the Royal Society on June 19. The report forms another and a conspicuous testimony to the remarkable growth of the laboratory and the importance and volume of the work with which it has to deal. In its early career the existence and future of the laboratory were a source of some anxiety to its supporters, but no one can now deny the position it has won. It will be readily conceded by those who have followed its fortunes how much the laboratory owes to its director, Dr. Glazebrook, to whose ability and energies the great success of the institution will be a lasting monument. A notion of the present extent of the laboratory buildings may be got from the panoramic view shown in Fig. 1. The laboratory staff now approaches 200 in number, of whom more than 60 have had a university training.

We observe that during the year under review the income of the laboratory amounted to more than 43,000*l*, an increase of more than 11,000*l*. on the previous year's working. Excluding a special grant of about 5000*l*., which is ear-marked for aeronautics research, and is separately administered, we notice that only 7000*l*. is contributed by the State towards this income; the greater part is derived from fees for tests, of which nearly 65,000 were carried out during the year, this total including all classes of work large and small. Some idea of the magnitude and importance of this work may be gathered from the fact that the value of the goods sent in for test approached 300,000*l*. for the year.

It is not without grave concern that the Royal Society views the financial responsibilities attendant on sums of this magnitude, but it is a tradition of political life in this country, and one unfortunately not frowned at by public opinion, that parsimonious State support should be given to public institutions which, however useful, do not by their very nature lend themselves to political aggrandisement. But he who runs may read, and the briefest scrutiny of the report before us offers abundant evidence of the intimate relations of the laboratory not only with the general public, but with the various departments of the Government itself. The board of control of the laboratory will have the warm approval of our readers in its efforts to get the grant-in-aid from the Treasury increased from 7000*l*. to a modest 12,000*l*. per annum.

There is an over-abundance of work waiting to be done, of problems to be solved, and it is both expedient and proper that much of this investigatory work should be financed by public funds rather than by levying a burdensome toll on the fees which the routine test-work affords.

There are many who urge that a National Physical Laboratory should act as a sort of headquarters for each and every branch of inquiry in physics, and that while its primary object is the application of science to industry, it should be prepared to lead the way in exploring new fields which are possibly and quite probably not immediately remunerative. But all these things cost money, and if public support is inadequate, it is the pure investigatory side which suffers rather than the utilitarian problems set by industry and commerce. The marked superiority of the State support in Germany and the States has greatly

FIG. 1.—General view of the National Physica Laboratory. In the foreground appears the long weaving-shed roof of the Tank Building. Behind this, in the centre, is the Wernher Building (Metallurgy), while on the left (North) is the small new building erected for experiments in the rolling of alloys. To the South (right) is the Metrology Building. In the rear of these again are, on the North, the Engineering Buildings, extending from the building for the 7-ft. air channel to the engine room chimney; the Electrotechnics Building, partly visible only behind the southernmost portion of the Engineering Buildings; the new Buildings opened by Mr. Balfour in June, 1913, for Administration and Optics (with Observatory Dome); and South-east of this and largely hidden behind the new Buildings, the original main Laboratory Building of Bushy House. The grounds of Bushy House extend to the South of the Buildings.

fostered the development of research in their respective national laboratories.

The National Physical Laboratory has taken part during the year in various international matters, such as the establishment of a practical scale of high temperature, the standardisation of screw-threads, and the questions underlying photometric measurements. The director served on Lord Parker's committee, which advised the Government on systems of long-distance wireless telegraphy; he is also a member of the committee appointed by the Postmaster-General to deal with the question of organised research in telegraphy and telephony. The new wireless laboratory which this committee has recently recommended should be established at Teddington, will work in close association with the National Physical Laboratory. In addition, the laboratory has taken a prominent part in the investigatory work incidental to the Home Secretary's committee (of which the director is chairman), which is concerned with the lighting of factories and workshops.

As mentioned above, the laboratory has been called on largely during the year to undertake important investigations for a number of Government departments. Among these may be mentioned an inquiry into the viscous behaviour of oil fuels for the Admiralty, and an investigation (for the Local Government Board) into methods of preventing glare from motor-car headlights. The work conducted for the Board of Trade and the Admiralty on ships' lights has been continued, while observations on the vibrations of St. Paul's Cathedral were made for the Home Office. Other investigations were carried out for the War Office, the Post Office, the India Office, the Crown agents, and the various Colonial Governments.

To turn to the research side of the work, Mr. F. E. Smith has completed a very important investigation on the absolute measurement of electrical resistance by means of an elaborate apparatus of the Lorenz type. The final value he obtains is that the ohm in the usual mercury units has a length of 106·245 ± 0·004 cm., which is distinctly less than the mean of previous results. Mr. Campbell has overcome with his well-known skill a number of difficult problems of measurement associated with the high frequencies used in wireless telegraphy, for an account of which reference must be made to the report. Mr. Paterson and Mr. Dudding have completed an inter-comparison of the photometric standards of the principal standardising laboratories of the world.

The heat division has contributed a series of interesting papers on the subject of the electric

FIG. 2.—The new library of the National Physical Laboratory; a memorial to the late Sir William White.

emissivity and disintegration of matter at high temperatures. An inquiry into the thermal and secular behaviour of various well-known thermometer glasses has been carried out, and some experiments on the thermal conductivities of certain highly insulating materials, which have been in progress for some time, are approaching completion.

Among the work of the metrology division we note some measurements on the silica standard metre constructed a few years ago. These fully bear out the high hopes which were originally entertained of this substance for the purpose.

An important new departure is the testing of radium preparations. The new department, which has been placed in charge of Dr. Kaye, has already proved a boon to the radium-buying public.

The engineering department has completed the work on wind pressure, and Dr. Stanton and Mr. Pannell have published a comprehensive and important paper on the frictional flow of fluids in pipes. In this work the authors have been able to rationalise the results over a wide range of velocities (20–6000 cm. per sec.) and for fluids with viscosities so far apart as those of air and water. The well-known index-law of frictional resistance was found to be inadequate over the large range of velocities employed.

The work of Mr. Bairstow and his colleagues in the aeronautical division has proved of the utmost value. The researches on stability and the gradual development of an aeroplane of complete stability (see NATURE, June 11, p. 388) have excited great popular interest and approval. A rolling-mill to deal with light alloys and a large 7-ft. wind-channel are approaching completion.

The results obtained in the laboratory of the road-board have already justified its existence. Some useful mechanical and endurance tests on various types of road mixtures have been carried out under many conditions.

The record of the metallurgical department is one of continued progress. The work on alloys research has proceeded apace, and much attention has been paid to the installation of the new equipment. We notice the proposed use of a kathode-ray furnace as a means of melting metals free from contamination.

The year has seen a great increase in the utilisation by various shipbuilders of the facilities offered by the national tank. It is gratifying to learn that the alterations in design suggested by the tests resulted in a considerable diminution in the power required, amounting on an average to 10 per cent. or more in the seventy odd models tested.

It is impossible in a short notice of this character to give anything more than the merest indication of a few of the fifty or more original papers which are reviewed in this report. Many of these are incorporated in the forthcoming eleventh volume of the "Collected Researches" of the laboratory. We notice an attractive list of researches proposed for the next twelve months' work.

ROYAL COMMISSION ON THE CIVIL SERVICE.

THE report (Cd. 7338, price 1*s.* 4*d.*) of Lord MacDonnell's Commission on the Civil Service is now published, and its chief recommendations were referred to in our issue of April 16 (p. 180); they may be summarised as follows:—

(1) That boys should be recruited only for permanent service, and no longer as temporary boy clerks.

(2) That in certain cases for which competitive examination is unsuitable, the appointment should be made by a selection committee.

(3) That a greater number of women should be employed, their appointment to be made by suitable means distinct from that used for men of similar grade.

(4) That the method of open competition should be maintained, and more closely coordinated with the educational system of the country.

The second of these recommendations concerns scientific and other professional appointments; though patronage is often wisely exercised, such appointments will in future be made by a suitably and regularly constituted committee. The Commission expresses no opinion as to whether the coordination of examinations and education will give increased weight to science. For the lower examinations the matter is left to the Treasury and the Civil Service Commissioners. For the Class I. examination the appointment of a committee is recommended to consider the coordination of the examination with university studies.

On the plan of the Commission there will be the following four

Methods of Appointment.

1. OPEN COMPETITION.—To be applied to most of the clerical posts (the higher among them to be now called Administrative Posts), and to professional appointments when the appointing age is less than twenty-seven. This involves some extension of the method in the case of professional and technical appointments. There is a nut for the Civil Service Commissioners to crack in the recommendation that character is to be tested by written examination—or perhaps the recommendation implies an interview.

2. DIRECT APPOINTMENT BY THE CROWN.—This method is at present used for high administrative posts and for some professional posts. Under the proposals of the Commission, only high administrative posts will be filled in this way, and when such a post is filled by the appointment of a man from outside the Service, the appointing minister will lay before Parliament a statement of his name and qualifications.

3. APPOINTMENT BY SELECTION COMMITTEE.—This method will be applied to professional posts when the appointing age is more than twenty-seven. There will be public advertisement of the vacancy, a picked number of the applicants (or perhaps all the applicants if the number is small) will be interviewed by an appropriately constituted committee, and the most suitable thereby

selected. This method is adopted by the Commission from the Board of Trade, which used it for the recruitment of the Labour Exchanges. In the circumstances it is curious that instead of acknowledging their debt the Commissioners find fault with the method adopted for the Labour Exchanges.

4. QUALIFYING EXAMINATION.—This method is used for subordinate posts for which educational attainments are of less importance than other qualities, postmen for instance. More than half of the posts in the Service are filled in this way, a greater number than by open competition. The Commission proposes that the Treasury should consider how to ensure that the patronage necessarily involved in the selection of these men shall be suitably exercised.

The General Civil Service.

A problem with which many have struggled is the finding of employment for the ex-boy-clerk, a problem which has resulted from a desire to spare the pocket of the taxpayer without sufficient regard to other circumstances. The boy is at present taken on and employed for a few years and then, in many cases, turned adrift. Many civil servants have laboured to find employment for the ex-boy-clerk. Their labours have, however, effected only an alleviation of the evil, and it is satisfactory to have the Commission decide that, in future, boys must be taken on only with a view to permanent employment provided their work proves satisfactory.

An aggravation of the evil was that in spite of the published regulations, many boys and their parents imagined that a boy selected by open competition for the Civil Service was made for life. The boy-clerk method of recruiting is to be replaced by a new class to be called the Junior Clerical Class, who will be recruited at the age of sixteen for permanent service. These boys are thus made for life in some sense, since provided they give satisfaction they may remain in the service and attain to a salary of 200*l*. It ought, however, to be made quite clear to this Junior Clerical Class that the bulk of them will be hewers of wood and drawers of water all their lives and never pass the 200*l*. limit. The staff posts to which these men may be promoted and the rare chances of promotion to a higher class will be small in numbers compared with the total numbers of the Class, and the bulk of the Class should be discouraged from looking forward to such promotion. Even so it will be difficult for a man who attains his maximum salary at thirty-six years of age to work on contentedly for thirty years more on that salary.

The General Civil Service will in future be recruited in three classes:

1. The Junior Clerical Class, appointed at sixteen at the close of the Intermediate School Course,

2. The Senior Clerical Class, appointed at eighteen at the close of the Secondary School Course.

3. The Administrative Class, appointed at the close of the University Course.

As already stated, the chief change is in the first-mentioned class which replaces the temporary boy-clerks. In course of time, when the Second Division Clerks have ceased to exist, their work will doubtless fall to the Junior Clericals. The second and third classes mentioned above are practically the Intermediate Class and the Class I. Clerks under new names. In all three classes, the conditions as to age and subjects are to be coordinated more closely than at present with the corresponding school epoch. It is, for instance, high time to abolish the test in copying manuscript which now stands in the examination schemes of the Boy Clerks and Second Division Clerks. The importance of the test to the Departments must be much reduced now that good handwriting is required of the Class I. Clerks.

MR. ROOSEVELT IN BRAZIL.

AT a special meeting of the Royal Geographical Society on Tuesday, June 16, Mr. Roosevelt gave an account of his recent journey in Central Brazil. In his opening remarks he alluded to the excellent work of the Telegraphic Commission under Col. Rondon in exploring the sandstone plateau which, under different names, extends west-north-west through northern Matto Grosso towards the cataracts of the Rio Madeira, and separates the drainage basins of the Paraguay and the Guaporé from those of the Xingu, Tapajos, and some of the tributaries of the Madeira. To the west of the affluents of the Juruena, the western fork of the Tapajos, they met with two considerable streams which they named the Ananaz and the Duvida; the ultimate courses of these were uncertain, hence the name, meaning "doubt" given to the latter. Beyond was another stream, which was descended and demonstrated to be the Gi-paraná, which enters the Madeira a little below San Antonio.

On Mr. Roosevelt's arrival in Brazil it was arranged that he and Col. Rondon should conduct an expedition down the Rio Duvida. Besides the two leaders, the *personnel* included Mr. Kermit Roosevelt, two American biologists, a Lieutenant of the Brazilian Engineering Corps, who determined the positions by astronomical observations, and a Brazilian army surgeon.

The expedition started in dug-outs from the bridge constructed by the Commission across the river, and for the first four days good progress was made, but then a succession of cataracts was met with, and forty-two days were occupied in covering one degree of latitude. All the cataracts had to be reconnoitred before they were negotiated, and in some cases the canoes had to be transported by land. At two points where low ranges of hills were traversed in narrow gorges the canoes had to be warped through with ropes. If, as was no doubt the case, these dug-outs were of the same type as those with which the writer was familiar on the Paraguay near its source, any craft less suited for descending rapids could scarcely be imagined. Mr. Roosevelt recommended future explorers to use Canadian birch-bark canoes in their place. When the last cataract had been left behind, about latitude 10° 50′ S., the first rubber worker was soon encountered, and others were met with at intervals down the river to its junction with the Madeira about latitude 5° 20′ S.

Mr. Roosevelt remarked on the fact that, though this was by far the most important tributary of the Madeira below the junction of the Beni and Mamoré, it did not appear on any map, except as a short and unimportant creek. It remains to be seen whether the whole of the water of the river takes this course. It seems quite possible that, when the river is high, some may pass into the Madeira by other routes, or may find an outlet into the Amazon by way of the Canumá channel, a lateral branch of the Madeira.

There is no doubt that the expedition has accomplished a valuable piece of work, and has, in Mr. Roosevelt's own words, placed a river comparable in size to the Elbe for the first time on the map. It is probably the most important achievement in river exploration in tropical South America since 1880, when Heath descended the Beni from Rurenabaque and showed that it united with the Manutata (Madre de Dios) and Mamoré to form the Madeira.

The collections made by the expedition should prove of interest, especially the rocks of the cataracts, which are on the line of strike of the crystalline rocks of the Madeira cataracts described by the writer. It was in descending the rapids that Mr. Roosevelt contracted fever, so that they appear to have the same malarial character as many other cataracts in South America, presumably because they offer facilities for the breeding of Anopheles in rock pools.

JOHN W. EVANS.

NOTES.

THE list of honours conferred on the occasion of the celebration of the King's birthday on Monday, June 22, includes the names of a few men of distinguished eminence in the scientific world, and of others who, while belonging to various departments of the public service, have done notable work for science. Among the new peers is Sir Leonard Lyell, Bart., a nephew of Sir Charles Lyell, and formerly a professor of natural science in the University College of Wales. Colonel S. G. Burrard, F.R.S., Surveyor-General in India, has been appointed a K.C.S.I., and Mr. R. A. S. Redmayne, C.B., Chief Inspector of Mines, Home Office, has been promoted to the rank of K.C.B. The new knights include :—Dr. J. G. Frazer, author of "The Golden Bough"; Dr. W. P. Herringham, Vice-Chancellor of London University and physician to St. Bartholomew's Hospital; Dr. W. H. St. John Hope, archæologist; Dr. W. Milligan, known by his investigation into the connection of human and animal anthrax; Lieut.-Colonel Leonard Rogers, Indian Medical Service, professor of pathology, Medical College, and bacteriologist to Government, Calcutta; Dr. T. Kirke Rose, chemist and assayer to the Royal Mint; Dr. S. J. Sharkey, lecturer on medicine at St. Thomas's Hospital; and Mr. J. F. C. Snell, president-elect of the Institute of Electrical Engineers. The honour of Knight Bachelor has been conferred upon Dr. Douglas Mawson, the Antarctic explorer, and Prof. T. P. Anderson Stuart, dean of the faculty of medicine at Sydney University. Mr. R. Meredith, Director of Telegraphs, India; Mr. A. Howard, imperial economic botanist at Pusa, Bengal; Major E. D. W. Greig, assistant director, Central Research Institute, Kasauli; Dr. T. Summers, late Bombay Public Works Department; and Mr. R. H. Tickell, chief engineer, Central Provinces, have received the honour of C.I.E. Dr. H. R. D. Spitta, bacteriologist to his Majesty's Household, has been appointed M.V.O. (Fourth Class).

AT the meeting of the London Mathematical Society on June 11 it was announced that the de Morgan medal had been awarded to Sir Joseph Larmor.

BY the will of Sir David Gill, the Royal Astronomical Society is bequeathed the sum of 250*l.* to be employed by the council of the society in aid of astronomical research in remembrance of the like sum paid out of the funds of the society in aid of his expedition to Ascension in 1876.

WE learn from the *Lancet* that the Emile Chr. Hansen prize for 1914, which consists of a gold medal and 2000 kroner (approximately 100 guineas), has been awarded to Prof. Jules Bordet, director of the Institut Pasteur of Brabant, in recognition of his original medical work in microbiology.

THE president of the British Science Guild (the Right Hon. Sir William Mather), and Lady Mather, have arranged to give a garden party to the members of the British Science Guild on Wednesday, July 8, at the Garden Club of the Anglo-American Peace Centenary Exposition, Shepherd's Bush.

THE work done on behalf of tropical medicine by Mr. Joseph Chamberlain and Mr. Austen Chamberlain has been commemorated by placing their portraits in bronze relief in the Albert Dock Hospital of the Seaman's Hospital Society. The tablets were unveiled on Tuesday by Mr. Harcourt, Secretary of State for the Colonies.

MR. G. A. HIGHT writes from Samer, Pas de Calais, giving particulars of the storm experienced on June 14. The rainfall measured at Samer during the storm between 12.50 and 2.45 p.m., was 3·86 inches, and nearly all fell before 2.15 p.m. The most remarkable feature of the storm was its local character, for in villages only two or three miles to the south of Samer there was no rain. During the storm the temperature fell from 70° to 61° F.

ACCORDING to a Reuter telegram from Copenhagen, Mr. Ole Olsen, the Danish millionaire, has offered to place sufficient funds for the fitting out of a north pole expedition at the disposal of M. Knud Rasmussen, the Danish explorer who has travelled much in Greenland and among the Eskimo. The expedition, which will take provisions for two years, will be provided with all modern appliances, and will be accompanied by a scientific staff. The base will be at Cape York, in Greenland. The expenses are estimated at about 15,000*l*. A start will probably be made in the summer of 1915.

OUR contemporary, the *British Journal of Photography,* is this year celebrating its diamond jubilee. The journal has been published continuously since 1854—that is, from the very early days of the wet collodion process—so that in its pages the history of photography is recorded as the events took place, with the exception of the still earlier daguerreotype period. It is fitting, therefore, that the diamond jubilee number, just issued, should contain a short history of the journal with portraits of its successive editors, and portraits of twelve "veterans of photography," the qualification for which class is an age of seventy or more, and a lifelong association with photography. With the special number is included a twenty-four page supplement, which gives an excellent summary of the history of photography, with many portraits and other interesting illustrations. Among the portraits is one of two of the "veterans," Sir William Crookes and Mr. John Spiller, taken fifty-nine years ago.

THE council of the Aeronautical Society of Great Britain has awarded the gold medal of the society to Prof. G. H. Bryan, F.R.S., for the great services he has rendered to aeronautics by his development of the theory of the stability of aeroplanes. Prof. Bryan is an old member of the society, to which in 1903 he communicated, in conjunction with Mr. Ellis Williams, a paper on the longitudinal stability of aeroplane gliders, containing the beginnings of the theory of stability he has since developed and published in his monograph, "Stability in Aviation" (1911). The previous recipients of the gold medal of the society, which is the highest award of British scientific aeronautics, are Wilbur and Orville Wright (1909), and Octave Chanute (1910). The official presentation of the medal to Prof. Bryan will take place next session at a date to be announced later.

THE nineteenth International Congress of Americanists (for the study of the ethnology and archæology of the Americas), will meet at Washington, October 5–10, under the patronage of the President of the United States and with the cooperation of the Smithsonian Institution, the universities, and other learned bodies. A full programme has been issued of the meetings, entertainments, and of a highly interesting excursion for the foreign members, to last rather more than two weeks. The principal cities and their museums will be visited and also New Mexico for the cliff-dwellings and pueblos. The Universities of Oxford and Cambridge have appointed delegates, and it is hoped that Great Britain may be fully represented, especially as the eighteenth congress was held in London, May, 1912. Members' fees, 1*l*., and associates, 10*s*., may be sent by money order to Dr. A. Hrdlička, National Museum, Washington, D.C., U.S.A. The proceedings will be issued to members only.

IT is proposed to erect, by international subscription a monument to the memory of Nicolas Louis de la Caille, at Rumigny (Ardennes). Among astronomers who have contributed substantially to the advancement of knowledge of the universe, de la Caille claims a distinguished place. He was the principal collaborator with the third Cassini in the measurement of the arc of meridian from north to south of France, with the view of settling the question as to whether the figure of the earth was oblate or prolate. He went on a mission to the Cape of Good Hope, and while there determined the positions of ten thousand stars, measured an arc of meridian in South Africa, thus starting the triangulation to connect the Cape with Cairo, his observations, combined with those of astronomers in the northern hemisphere, giving increased accuracy to the determination of the moon's distance. His work, completed in less than four years, was commemorated by the Royal Society of South Africa in 1901 by the erection of a tablet on the house in which he lived in Cape Town. He was one of the leading lights of the eighteenth century, and his work merits the monument which it is proposed to erect. The president of the executive committee which is appealing for subscriptions is M. Baillaud, director of the Paris Observatory, and the members of the honorary committee include many distinguished astronomers in France and elsewhere.

THE International Fire Service Council's executive held a series of meetings in London on June 15–19, at the invitation of the British Fire Prevention Committee. The meetings have been honoured by his Majesty wishing the council success; the delegates have been received on behalf of his Majesty's Government, who have entertained them at luncheon, when the Earl Beauchamp, presiding, took the opportunity to express his appreciation of their work and its beneficial influence, and the London County Council has entertained the visitors and afforded them numerous facilities. The work of the International Council, which was presided over by Commandant Meier, of Amsterdam (president of the council), included the technical arrangement of the proposed International Fire English-French-German Dictionary of 5000 technical terms, which the council will now be able shortly to issue, thanks to the liberality of an English donor who has offered to bear the cost of its production. Arrangements were made for the holding of a full meeting of the council and an International Fire Congress at Copenhagen in 1915, when questions relating to celluloid dangers, fire on board ship, petroleum dangers, and the formation of county or district motor fire brigades are to be under consideration.

LAST Saturday, June 20, the Physical Society held a meeting at Cambridge. A party of about one hundred travelled from London, and proceeded to the works of the Cambridge Scientific Instrument Co. After inspecting the works, the members and their friends were entertained by the company at a luncheon in the hall of St. John's College. The president, Sir J. J. Thomson, in expressing the thanks of the society for the company's hospitality, directed attention to its excellent work, and to the part it played in putting into a commercial form the crude ideas of the pure physicist in developing new instruments. Mr. Horace Darwin, chairman of the company, in responding, remarked that it aimed at turning out not only well-finished instruments, but also instruments that would last owing to good design. In referring to the president of the society, Mr. Darwin directed attention to the remarkable succession of professors at the Cavendish Laboratory, namely, Clerk Maxwell, then Lord Rayleigh, and now Sir J. J. Thomson. He concluded by thanking the master and fellows of St. John's College for permitting the lunch to be held in the hall. After a reply by Dr. G. D. Liveing, the members visited some of the colleges and proceeded to the Cavendish Laboratory, where Sir J.J. Thomson read a paper on the production of very soft Röntgen radiation by the impact of positive and slow kathode rays, and Mr. F. W. Aston read a paper on the homogeneity of atmospheric neon. This was followed by tea by invitation of Sir Joseph and Lady Thomson, and experimental demonstrations in the laboratory.

DR. WOLBACH and Mr. Binger describe two new spirochæte organisms (*S. elusa* and *S. biflexa*) from pond-water. The former was cultivated in hay infusion; it is very minute, and is filterable through a Berkefeld filter (*Journ. Med. Research*, vol. xxx., No. 1, 1914).

BULLETIN No. 92 of the U.S. Department of Agriculture gives an account of experiments by Dr. White on the destruction of germs of infectious bee diseases by heat. Temperatures of 63° C. for European foul brood, 98° C. for American foul brood and 58° C. for sacbrood and Nosema disease, with an exposure for ten minutes, were found effective. These data may be of practical service in preventing the ravages of these diseases.

IN the Memoirs of the Department of Agriculture in India (Veterinary Series, vol. ii., No. 3, 1914) Major Holmes details tests of the curative value of iodine and of carbolic acid on hæmorrhagic septicæmia and rinderpest, two important cattle diseases, in which the mortality is about 90 per cent. Iodine treatment reduced the mortality in hæmorrhagic septicæmia to about 50 per cent., and in rinderpest to about 67 per cent. Of ten rinderpest animals treated with carbolic acid, three survived, a mortality of 70 per cent. Potassium permanganate was found to have no curative value in either disease.

IN the *Quarterly Journal of Microscopical Science* for June (vol. lx., part 2), Prof. Arthur Willey gives a description of the blastocyst and placenta of the beaver, having been fortunate enough to obtain much younger stages than any hitherto known. In the same number Prof. G. C. Bourne describes a remarkable new type of Alcyonarian, to which he gives the name *Acrossota liposclera*. The specimen was collected by Prof. Willey near British New Guinea, and differs from all other known Alcyonarians in the possession of simple, unbranched tentacles. The tentacles are, however, always eight in number, and in other respects also the species is typically Alcyonarian. A new family, the Acrossotidæ, is proposed, and placed in the order Stolonifera of Hickson.

EXCELLENT photographs illustrative of the breeding habits of the pratincole and the Kentish plover form one of the striking features in the June number of *Wild Life*.

WE are indebted to Dr J. Ritchie for a copy of an article in the May number of the *Scottish Naturalist* on early references to the occurrence of four-horned sheep in Scotland. The earliest of these is in a work on Scottish affairs by Bishop Leslie, published in Rome in 1578.

THE care of home aquaria is one of two titles given to a small illustrated pamphlet by Dr. R. C. Osburn, published by the New York Zoological Society. In the United States small aquaria, both marine and fresh-water, appear to be much more common at the present day than they are in this country; and the tract is intended for the use of beginners in the cult. Dr. Osburn emphasises the importance of a proper balance between animal and vegetable life in the tank, and, when this is established, the harmfulness of frequent change of the water.

MR. O. A. M. HAWKES has devoted a large amount of time and labour to the study of the relative lengths of the first and second toes of the human foot, from the point of view of occurrence, anatomy, and heredity, the results of which are published, with a number of sciograph and other illustrations, in the April number of the *Journal of Genetics*. Three chief types are noticeable, in the first and most common of which the "great" toe is longer than any of the others; in the second type the maximum length occurs in the second toe, while in the third, and rarest, type, the first and second toes are equal in length and longer than any of the other three.

AT the Monaco International Zoological Congress it was resolved that a certain number of well-known generic names of animals which, on grounds of priority or for other reasons, are liable to replacement, might be submitted to the International Commission on Nomenclature for retention by "fiat." A list—signed by Messrs. K. Andersen (Denmark), E. Lönnberg (Sweden), A. Cabrera (Spain), R. Lydekker (England), P. Matschie (Germany), O. Thomas (England), and E. L. Trouessart (France)—of sixteen mammalian names recommended for conservation in this manner has now been drawn up with the view of presentation to the commission. The scheduled names are Anthropopithecus (chimpanzi), Cercopithecus (guenon monkeys), Chiromys (aye-aye), Cœlogenys (paca), Dasypus (six - banded armadillos), Dicotyles (peccaris), Echidna (spiny ant-eater), Galeopithecus (flying-lemur), Gazella (gazelles), Hapale (marmosets), Hippotragus (sable and roan antelopes), Lagidium (mountain chinchilla), Manatus (manatis), Nycteris (certain African bats), Rhytina (Steller's sea-cow), and Simia (orang-utan). Hyrax (rock-conies) might well have been added. It is to be hoped that not only will the commission issue the "fiat," but that naturalists will make a point of accepting the names thus legalised. In many instances their rejection involves the transference of names from one genus to another (as, for instance, Simia from the orang-utan to the chimpanzi, and Cynocephalus, so long used for the dog-faced baboons, to the flying-lemur), which is the worst of all evils in zoological nomenclature. Echidna will have to be disused in ichthyology.

Among recent additions to the Natural History Branch of the British Museum, the following specimens are of general public interest:—The skeleton of the thoroughbred stallion, "St. Simon," presented by the Duke of Portland, which is not yet on exhibition, but is, we understand, to be placed alongside the skeleton of his son, "Persimmon," presented by his late Majesty King Edward VII. "St. Simon" was foaled in 1881, and was never beaten on the Turf. Another highly interesting skeleton is that of the Egyptian Eocene two-horned ungulate, Arsinoëtherium, which has just been set up in the fossil mammal gallery. As a matter of fact, this skeleton is a restoration in plaster, but as nearly all the elements have been modelled from actual bones, it is practically as good as if an original. As mounted, the skeleton is about 11½ ft. in length from the muzzle to the root of the tail, a striking feature being the very wide interval between the limbs of opposite sides. The precise affinities of this strange beast are still unknown. In the upper mammal gallery the attention of the public has been riveted on a gigantic specimen of the eastern race of the gorilla (*Anthropopithecus gorilla beringeri*), from the neighbourhood of Lake Tanganyika, recently presented by the Rowland Ward Trustees. In addition to its huge size, this race is characterised by the great development of long black hair on the head, shoulders, and buttocks, and the restriction of the grey band on the back to the loins. On entering the museum the visitor should inspect a segment of the trunk of a fossil conifer from the Trias of Arizona, presented by Mr. Arthur Pearson, and placed by one of the pillars on the right side of the hall. This specimen, which weighs about 2½ tons, has an adventitious interest on account of the brilliant colours presented by the silicified wood, as is admirably shown in the polished upper surface.

The report of the Sonnblick Society for the year 1913 contains, in addition to the usual meteorological observations at the summit of the Sonnblick, Salzburg (3105 metres), and at other alpine stations, two papers of considerable interest. The first deals with the force of gravity on the Sonnblick, and with general considerations on the earth's gravity, by Major L. Andres. It was intended that General v. Sterneck, who was greatly interested in the subject, and had made numerous determinations in various parts, and had also designed a simple, portable pendulum instrument, should superintend the work, but this was prevented by his death in 1910. The second paper relates to recent scientific research at the Hochobir Observatory (2043 metres) in connection with the determination of the effect of difference of height on the magnetic elements, and with experiments on atmospheric electricity. Good results are here being obtained with pilot balloons, which can be followed to very great heights, owing to the clearness of the air.

Since 1783 there has been no great eruption of the Asama-yama, and chief volcano of Central Japan, though the minor explosions and frequent earth-tremors of the last few years seem to point to an approaching period of activity. During the summer months the tremors are recorded at the observatory of Yuno-taira, which lies 1900 ft. below the summit on the south-west slope of the mountain. Prof. Omori, who has studied these records (Bull. Imp. Earthq. Inv. Com., vol. vi., 1914, pp. 149–226), shows that the tremors belong to two classes. Those of the first group (1065 in number, of which one in six were sensible) consist of quick vibrations, are generally of short duration, and never occur during eruptions. The tremors of the second group (1688 in number) consist of slow and always insensible movements, which are of comparatively long duration, and invariably accompany eruptions. In 1911 the average daily number of tremors was eight, and in 1912 eleven.

La Société Belge de Radiologie has issued (L. Severeyns, Brussels, price 6 francs) a series of articles on the medical applications of radio-activity by Prof. J. de Nobele, University of Ghent, MM. Paul Giraud, Jacques and Gaston Danne, and Dr. Henri Coutard, of the Laboratoire de Radio-activité de Gif, près Paris, entitled "Conferences de Radiumbiologie; faites a l'Université de Gand en 1913." The publication deals chiefly with the work at M. Danne's private laboratory at Gif, and is provided with numerous illustrations of the laboratory and the various apparatus there employed. A number of sufficiently striking illustrations, in M. Giraud's article, show the healing of various growths successfully treated with radium. Dr. Coutard contributes a very full and valuable bibliography dealing with the biological side of radio-activity, which occupies sixty pages.

In the *Verhandlungen* of the German Physical Society for May 15. Dr. E. Gumlich describes a modification of the isthmus method of testing the magnetic qualities of iron in fields of the order of 7500 gauss, which has been found to work very well at the Reichsanstalt. The specimen to be tested consists of a cylindrical rod 0·6 cm. diameter, 35 cm. long, which passes through the 0·6 cm. diameter central holes in two soft iron cylinders of 2·5 cm. outer diameter and 17 cm. length. Between the two cylinders the testing coils, 1·2 cm. wide, are placed. These coils are wound in four layers, so that from the throw given by a ballistic galvanometer connected either to the inner layer or to two consecutive layers in opposition, the induction or the magnetising field outside the specimen can be determined. A slight modification of the arrangement allows transformer sheet to be tested in the same way, the magnetising coil necessary to provide the magnetic flux through the yoke connecting the two cylinders in either case being comparatively small.

We learn from the *Engineer* for June 19 that a very large installation of Humphrey gas pumps has been ordered by the Egyptian Government for the drainage of Lake Mareotis at Mex, near Alexandria. When completed, there will be eighteen pumps, each capable of delivering 100,000,000 gallons a day through a lift of 20 ft. The present order comprises the first ten pumps, together with the necessary gas producers, Venturi meters, etc. The great size of the pumps may be judged from the fact that their capacity will be between two and three times that of the pumps installed at the Chingford Reservoir. The combustion chambers will have a maximum internal diameter of 8 ft. 8in., and a height of 14 ft. approximately. Each water valve box will be 8 ft. 8 in. in diameter, and 7 ft. high, and will have 100 valves of the hinged type, specially designed to enable any valve to close upon an obstruction without throwing undue stress upon the hinges. On the next stroke, when the obstruction has been removed by the rush of water, the valve will readjust its position automatically and close fairly upon its seat.

THE accidental subsidences which occurred in Paris a few days ago on one of the Paris Metropolitan lines now in course of completion form the subject of an article in *Engineering* for June 19. The driving of the new underground line appears to have been the immediate cause of the catastrophe. The existing masonry sewers seem to have been shored up over the tunnel driven to take the line; they appear to have broken down at parts during the violent storm of June 15, and the water, by flowing into the tunnel, led to undermining and to the caving-in of the tunnel arch by carrying away the earth and stone on which the arch rested temporarily, and also by carrying away at intervals the masonry walls which formed its final support. It is quite evident that the excavation work, which the construction of the new lines involves, is surrounded with most serious difficulties, carried out as it is in the very soft earth which constitutes the subsoil of Paris, amongst a most complicated network of sewers and pipes, and very frequently through bodies of underground water. It is too early to draw conclusions from the disaster, but one point would seem to stand out clearly, and this is to the effect that no precaution and no reasonable amount of timbering should be deemed superfluous when driving a large network of tunnels in a treacherous subsoil like that of Paris.

OUR ASTRONOMICAL COLUMN.

COMET NOTES.—Zlatinsky's comet (1914*b*) is gradually becoming fainter and getting further south, but the following ephemeris, calculated by Prof. Schwassman (*Astronomische Nachrichten*, No. 4739) of Bergedorf, will permit of it being followed with larger instruments :—

	R.A. (true) h. m. s.	Dec. (true) ° ′ ″	Mag.
June 24 ...	9 24 16·2	... −9 3 15 ...	8·8
25 ...	25 49·9	... 9 36 3	
26 ...	27 20·2	... 10 7 29	
27 ...	28 47·6	... 10 37 41 ...	9·1
28 ...	30 12·2	... 11 6 44	
29 ...	31 34·4	... 11 34 42	
30 ...	32 54·4	... 12 1 41	
July 1 ...	9 34 12·2	...−12 27 46 ...	9·4

The comet discovered by Kritzinger (1914*a*) is a circumpolar object due to its large positive declination. An ephemeris is published in *Astronomische Nachrichten*, No. 4739, by M. P. Chofardet, and the following are the positions for the current week :—

	R.A. h. m. s.	Dec. ° ′
June 25 ...	22 0 50	... +44 49·8
27 ...	5 35	... 44 50·3
29 ...	10 2	... 44 48·0
July 1 ...	14 12	... 44 43·7
3 ...	22 18 4	... +44 36·7

Elements and ephemeris for Delavan's comet (1913*f*) are also given in the same number of the *Astronomische Nachrichten*. This comet is now about the 9th magnitude, and is brightening up considerably, but cannot yet be observed owing to its nearness to the sun. It will be picked up, however, somewhere about the latter end of July.

LARGE TELESCOPES.—Mr H. P. Hollis publishes (*Observatory*, June) a very interesting list of large refractors and reflectors, either under construction or already set up in observatories. In the case of refractors, the lower limit of aperture of the object glass is taken as 20 in., and the same limit is also taken in the case of the reflecting telescopes. Of the thirty-eight refractors about which details are given, the largest objective is that of 49·2 in. made for the Paris Exhibition of 1900. As this is out of use, the largest working objective is that of the Yerkes Observatory at Wisconsin, U.S.A. Of the refractors under construction the following may be mentioned :—A 32-in. for the Nicolaieff Observatory, Russia; a 26-in. for the Union Observatory, Johannesburg; three 24-in. for the following observatories: Argentine National Observatory, Cordoba, Chili National Observatory, Santiago, and the Detroit Observatory, Michigan, U.S.A., and a 20-in. for the Chabot Observatory, Oakland, California. The Earl of Ross's 72-in. reflector holds the field for the largest reflector (metallic speculum), while Dr. Common's 60-in. (silver on glass), now at the Harvard Observatory, U.S.A., comes second. Of those under construction, two giants are in hand, namely, one of 100 in. for the Mount Wilson Solar Observatory, and one of 72 in. for the Dominion Observatory, Canada. Others under construction are a 40-in. for the Simeis Observatory, Crimea, and two of 30 in., one for the Helwan Observatory, Egypt, and the other for Mr. D'Esterre's observatory, Surrey, England. It is interesting to note that the number of instruments in each list is about the same, namely, thirty-eight refractors and forty reflectors.

A PLANET BEYOND NEPTUNE.—Mr. H. E. Lau contributes to the June number of *L'Astronomie* a short account of his researches on the perturbations of Neptune and Uranus leading him to suggest a case for a planet beyond Neptune. He produces some interesting and suggestive curves showing the apparent irregularities of the movement of Uranus according to the errors of the tables after Newcomb, Gaillot, and himself. As regards the conclusions he draws at the end of his article he states that they should only be accepted with extreme reserve. The researches made by M. Gaillot and himself, "établissent seulement que l'hypothèse des deux planètes transneptuniennes n'est pas en *conflit* avec les faits observés de sorte qu'il *peut exister deux ou plusieurs grosses planètes au dela des limites actuelles du système solaire.*"

RECENT PROGRESS OF ASTRONOMY.—In the *Annuaire de l'Observatoire Royal de Belgique* for 1914 Prof.

Paul Stroobant contributed a large section dealing with the progress of astronomy during the year 1912. This section has now been issued in a small book form, and will be found very handy and useful for reference.

NEW PHYSIOLOGY SCHOOL AT CAMBRIDGE.

ON June 9, H.R.H. Prince Arthur of Connaught opened the new physiological laboratory erected by the Drapers' Company, and presented by it to the University of Cambridge. A comparison of the old laboratory with the new illustrates the remarkable increase in complexity that has taken place in recent years in physiological investigation. The old laboratory, the last part of which was built in 1891, was for some years amongst the best in the country, yet it had no electrical supply, and the research rooms simply afforded space without any adaptation for special purposes. The following account of the chief features of the new laboratories will show how the conditions have altered. The building is 162 ft. long and 44 ft. broad. The eastern half consists of five storeys, the western half has the fourth and fifth storeys thrown together to form one large room with a gallery. Electric light is throughout. The rooms are supplied with 4-volt and 110-volt current from a storage battery, and in many of the rooms the current can be taken from plugs hanging from the ceiling. The battery has a capacity of 480 amperehours; it is charged from an external power station, and the current can be taken direct from this when arc lamps are in use

Compressed air is supplied to the research rooms, at a pressure of 25 lb. to the sq. in.; the compressor has an automatic switch which starts the motor when the pressure drops to 12–15 lb. to the sq. in. The compressed air, besides its other uses, is employed for aerating the water in the tanks of a small room fitted up as an aquarium. Some of the tanks contain seawater for marine animals, and by the method employed, the sea-water only requires renewal about once in three months.

There is a special boiler for supplying hot water to the sinks, and a destructor for burning animals killed in the laboratories. On the ground floor is a refrigerator plant keeping a small room above it on the first floor at 0°–3° C.

New Physiology School, Cambridge. View from N.W. The large lecture room and the biochemical department will form a wing on the E. side of the entrance door.

Two rooms are fitted up for research in electrophysiology, each having a dark room, so that photographic records of the electrometer, and string galvanometer, can be taken. These are on the ground floor, which is 5 ft. below the surface; the stone slabs on which the instruments rest are practically devoid of vibration. Two rooms on the same floor are arranged for thermo-electric research, and a continuous record can be taken of the heat given out by small animals over a period of several days. Two communicating rooms are designed for surgical operations; one of these, and some of the experimental rooms, have a special arrangement of hot-water pipes for heating to 75° C. Adjoining these are experimental rooms with kymographs. There are three dark rooms, one for developing photographs, one for visual observations, and one for X-rays. The ordinary table for X-ray observations has been modified for work on anæsthetised animals. An ultra-microscope is installed in the room devoted to research on colloids. On the north side of the second floor are rooms for microscopic and experimental neurology. Three rooms are specially fitted for blood gas analysis. The laboratory also contains a large library well supplied with physiological books and periodicals.

The class-rooms occupy the fourth and fifth floors; there are two large experimental rooms, one for elementary and the other for advanced work, and a histology room with places for 150 students. Adjoining is a small demonstration room, holding about fifty, and on the first floor is a larger demonstration room, holding about eighty. This latter room has dark blinds, moved up and down by a motor, which can be set in action from the lecturer's table. It is fitted with epidiascope and with kinematograph.

The architect of the building is Sir Thomas Jackson. In the wing to be built later on the north side will come the large lecture room and some additional rooms and offices.

ORNITHOLOGICAL NOTES.

TO the February number of *British Birds* the Rev. F. C. R. Jourdain and Mr. Clifford Borrer contribute an article on erythrism in the eggs of British species, that is to say, eggs in which the normal type of colouring has been replaced by one in which the markings are of various shades of red or reddish-brown; in other words, those in which the pigment consists solely of oörhodein; but the range of colour-variation in the species includes eggs coloured with bile-pigment (biliverdin), either alone or with other pigment, to form the various greens and blues. For this reason the eggs of the Accipitres, which, although really erythristic, seldom show traces of other colouring matter, are excluded. As might have been expected, the erythristic variation generally extends to the entire clutch. Whether individual birds which lay erythristic eggs in one season, do so always, is a point to which no reference is made.

In the *Selborne Magazine* for February members of the Committee for the Economic Preservation of Birds direct attention to species of which the plumage may be used without involving any destruction other than would normally occur, as in the case of game-birds, or without any destruction at all, as in the case of the ostrich, rhea, and, it is said, the peacock. On the other hand, it is urged that the slaughter of mischievous species, like many of the grain-eating parrots, is justifiable, and therefore that their plumage may be worn.

The feature of the winter number (1913) of *Bird Notes and News* is a coloured plate by Mr. Lodge of some of the species most severely persecuted by the plumage-trade. Statistics of the numbers of skins of various species offered at the London auctions are given, in connection with the Plumage Bill.

Bird-Lore (D. Appleton and Co., Harrisburg and New York) for January and February is a good number, containing two coloured plates, and the fourteenth annual census of the local migrations of well-known American species. One of the results is to show that during the past season "chickadees," which seldom come so far south as Massachusetts, reached Rhode Island, Connecticut, and Rhinebeck.

From a paper by Mr. H. Victor Jones in the February number of the *Zoologist* on certain parasites of birds, we learn that while rooks and the diurnal birds-of-prey—probably owing to the strength of their gastric juices—are practically free from intestinal infestations of this kind, curlews show, on the average, no fewer than 49·5 per head. As there seems to be a connection in many species between the numbers of external and internal parasites, it is suggested that some of the former may serve as hosts for the latter during the earlier stages of their development.

As one of the results of bird-protection, there are hopes that kites may soon be seen in districts from which they have long since disappeared. During the last few years these birds have increased considerably in numbers in Wales, and it is probable that the pair recorded by Messrs. Hale and Borrer in the March number of *British Birds* to have bred in Devonshire in the spring of 1913 were emigrants from that colony. Kites are also recorded in the same issue, on more or less satisfactory evidence, to have been seen during 1913 in Somersetshire, Derbyshire, and Buckinghamshire.

According to the January number of the *Emu*, it is expected that an Act for the reservation of 300 acres to serve as a bird-sanctuary in Kangaroo Island will be passed by the Commonwealth Government next session. Lyre-birds, formerly abundant in very similar country in the Blackall Ranges, would probably flourish there. It is also recorded that at the annual congress of the R.A.O.U. a resolution was unanimously carried calling on the Government to pass a local Act on the lines of the British Plumage Prohibition Bill.

In the *Field* of March 28 Mr. Seth Smith directs attention to the remarkable cry uttered by the king penguin in the Zoological Gardens. The bird is shy of going through the performance, but if gently stroked on the throat by its keeper will gradually raise its head and stretch its neck to the utmost, then, throwing out its chest, it emits a series of loud, trumpeting sounds which last for some seconds; the bird on the utterance of the last note suddenly drops its head, as if bowing to the audience. The "song" and the concluding gesture are probably the "display" of the penguin, for in bowing it exhibits to the best advantage the brilliant golden patches on the sides of the head. As these patches are not confined to the male sex, it is probable that both sexes "display."

The feeding habits of the South African ground-hornbill (*Bycanistes buccinator*), as exemplified in a pair of tame specimens, form the subject of a note by Mr. C. F. M. Swynnerton in the Journal of the South African Ornithologists' Union for December, 1913. Their extreme voracity, the lightning-like rapidity with which they would seize rats in a barn, and the small size of many of the insects upon which they fed, were some of the most noticeable features of these great birds. After devouring half a score of rats at one meal, these birds would be ready for a second meal an hour later; and they would seize and eat house-flies with the same apparent zest as they devoured rats.

The beaks of crossbills are not always crossed in the same manner, the upper half in some individuals crossing to the bird's own right, while in others the reverse condition obtains. Examination of 171 specimens has enabled Mr. Miller Christy to state, in the April number of *British Birds*, that, so far as this evidence goes, the numbers of the two types are approximately equal—eighty-four of one type and eighty-three of the other, with four specimens indeterminable. This, it is suggested, is an indication that the crossing of the beak is of recent origin, and therefore probably not a Mendelian feature.

The following extract is from a letter received by the editor from the London correspondent of the *North Queensland Gazette*, relating to an alleged remarkable habit on the part of those birds of paradise commonly known as rifle-birds (Ptilorhis):—

"The birds collect sloughed snake-skins for use in connection with their nests. When the construction of the nest is finished, they place these skins around the outside of the structure in such a natural manner as to convey the impression to a casual observer that a living snake is coiled there. . . . A hawk, eagle, or crow, observing what it takes to be a nest with a snake coiled about it, is not likely to desire closer acquaintance." R. L.

THE ROYAL CANADIAN INSTITUTE.

ESTABLISHED in 1849 at Toronto, then Upper Canada, through the energy and activity of a rising young engineer, Mr. (now Sir) Sandford Fleming, as secretary, the "Canadian Institute" was incorporated by Royal Charter on November 4, 1851, and the title "Royal" has recently been conferred upon it. From the first this institute discussed questions and published memoirs of world-wide interest, under the able guidance of men of the type of Sir Sandford Fleming, Kivus Tully, Sir William E. Logan, E. Billings, Henry Youle Hind, Thomas Ridout, J. C. Browne, and others.

The objects of incorporation included the encouragement and general advancement of all the sciences, arts, and manufactures; in fact, for promoting all branches of knowledge dealing with the resources and development of a new country, not forgetting industrial productions and commerce, besides the establishment of a museum to promote the purposes of science and the general interests of the society. For sixty-five years these objects have been pursued by the institute, and with a membership of sixty-four in 1850, the number has increased to nearly 400. The institute has published volumes of Transactions that are a credit to its good name, both in its earliest days and of recent date. The institute has also materially assisted Sir Sandford Fleming in his publications on the zone system of time reckoning, which has been adopted the civilised world over. In its library there is found excellent reference material in many departments of special research work. In 1913 the number of exchanges received by the Royal Canadian Institute was 2180, whilst the publications received annually now reached 4000. Weekly meetings take place during the season, when leaders of thought in science, history, and literature are invited to take part in the reading of papers, and delivery of lectures. These meetings are open to the public.

It was on April 2 of this year that the title "Royal" was conferred on the Canadian Institute of Toronto by his Majesty King George V., recognition of the same having been intimated to the institute through his Royal Highness Field-Marshal the Duke of Connaught, Governor-General of Canada. Besides sending a personal message to his Honour, Sir John Gibson, Lieutenant-Governor of Ontario, conveying his warmest congratulations to the Royal Canadian Institute on the recognition and honour conferred upon them by H.M. the King, his Royal Highness showed his interest in the institute and its progress by accepting the post of patron. A communication was read from Sir Sandford Fleming (Ottawa), and congratulatory speeches and addresses were given, in which Sir Edmund Walker, President Falconer, Principal Peterson, Dr. Coleman, F.R.S., and the presiding officer, Mr. Frank Arnoldi, K.C., took part. Sir Sandford Fleming was unanimously elected honorary president of the new "Royal Canadian Institute," and his three sons, Sandford, Walter, and Hugh, were formally elected members under the new title.

H. M. AMI.

THE CAMBRIDGE "PREVIOUS" EXAMINATION.

THE syndicate appointed by the Senate on May 9, 1913, to "consider what changes, if any, are desirable in the regulations relating to the Previous Examination, in the mutual relations of the Previous Examination and the examinations held by the Highest Grade Schools Syndicate and the Local Examinations and Lectures Syndicate," has reported on somewhat drastic lines.

The syndicate has considered carefully the regulations and arrangements for the existing Previous Examination, and other examinations which are accepted as exempting from the Previous Examination, and has consulted the representatives of the Board of Education, the Headmasters' Conference, the Incorporated Association of Headmasters, and the Assistant-masters' Association, as well as certain members of the University of Oxford, who are concerned with analogous inquiries.

Two hundred headmasters of public and secondary schools sent replies to questions which were addressed to them by the syndicate. The syndicate is of opinion that the existing Previous Examination is an unsatisfactory test, and is not adapted to the present situation in secondary education, and it therefore recommends the introduction of changes, both administrative and educational.

The administrative change advocated is the establishment of a new syndicate which shall be called the Examinations Syndicate, which would take over the work of the present Local Lectures and Examinations Syndicate, so far as examinations are concerned, and of the Highest Grade School Examinations Syndicate. The new syndicate would control the whole of the "pass" examinations of the University.

The educational changes, proposed in the report, endeavour to coordinate the examinations which qualify for study at the University with the entrance examinations to the various professions; and throughout the deliberations the scheme of the Board of Education which is designed to assist such coordinations has been kept in view.

The syndicate proposes to abolish the distinction which now exists between the examination for candidates for honours and that for the "pass" degree. The additional subjects will be done away with.

The compulsory subjects which remain are divided into three groups, each of which may be taken separately. The first group consists of languages; two papers will be set in each of the following:—Latin, Greek, French, and German. Greek is no longer to be compulsory, but Latin must be one of the languages offered.

The second group consists of mathematics and science: algebra and arithmetic, geometry, physics, and chemistry, or experimental mechanics.

The third group consists of English: essay and précis writing, selected books, and outlines of English history.

The examination will be held four times a year at Cambridge only.

The report will be discussed by the Senate at the beginning of the October term. So far as can be gathered, the resident opinion is in general favourable to its findings, though there is sure to be some criticism as to detail by the much-enduring college tutors who will find the task of entering their pupils complicated.

THE GULF STREAM.[1]

MANY theories have been advanced to account for ocean currents in general and for the Gulf Stream in particular. Their causation has been attributed by various writers to:—(1) Differences in the temperature and density of the sea in widely separated geographical positions. (2) Differences in level due to inequalities in different regions of evaporation and precipitation; and to the outflow of great rivers. (3) To convection currents. (4) To the rotation of the earth on its axis. (5) To the direct action of persistent winds.

Wind is the prime cause of all currents; persistent winds the motive power to which all the great ocean streams may be assigned. If anyone be in doubt as to the fact, let him place tracings of maps on which the direction of the principal currents of the globe in the different months or seasons of the year are indicated, over maps on the same scale on which wind distribution, referable to the same months or seasons, is shown; and it will be seen how closely the currents follow the direction of the wind, and how quickly the former respond to changes in the direction of the latter.

In this connection the course of the equatorial current of the Indian Ocean, on the western side of the Arabian Sea, may be cited as a striking example. During those months when the north-east monsoon prevails the current in that region turns to the southward and joins the Mozambique current, but as soon as the change in the direction of the wind occurs, and even before the south-west monsoon is established, the current swings round and flows in the new direction of the wind, to the northward and eastward.

All winds by friction cause some movement of the water surfaces over which they blow, while the waves, and even the wavelets they raise, add impulse to the motion; the stronger the wind the greater being its effect at the time. This surface movement caused by wind is gradually imparted to the water layer below it, and when the wind persists in the same direction for long, the motion is transmitted from layer to layer to a considerable depth.

Under the influence of the trade winds, the currents when nearing equatorial regions probably extend to a depth of from 200 to 400 ft.

Although the principal currents are produced and maintained by the action of persistent winds, their direction is largely controlled by the rotation of the earth on its axis and by variation in temperature and in density, also in evaporation and precipitation in different geographical positions, but these exert only slight local modifying effects. Moreover, as regards the Gulf Stream and its causation, it was found by the officers of the United States Coast Survey that the Atlantic Ocean at Sandy Hook was 3 to 4 ft. lower than the waters of the Gulf of Mexico at the mouth of the Mississippi. This difference of level, which is said to have been ascertained by accurate measurements, doubtless is caused by the heaping up of water in the gulf by the equatorial current; and the power requisite for maintaining the constant flow of the Gulf Stream through the Strait of Florida must in a large measure be attributed to this agency.

The warm, relatively high salinity water which undoubtedly exercises an ameliorating effect upon the climate of our islands and upon that of north-western Europe generally is mainly of equatorial origin, and is directly attributable to the agency of the Gulf Stream.

In support of this belief, let me refer you, in the first place, to a chart of surface temperature of the North Atlantic in order to show what evidence the distribution of mean annual surface temperature will reveal.

The effect of the collision between the Gulf Stream and the cold Labrador current is boldly marked by the steep temperature gradient from 40° to 46° N. Now trace the course of the isotherms onward. The isotherm of 50°, which on the 50th meridian is in 43° N. lat., on the 28th meridian is in 60° N.; the isotherm of 52°, which on the 50th meridian is situated only a few miles south of the 50° isotherm, on the 10th meridian is in 57° N.; but the isotherm of 60°, which on the 50th meridian is in about 41½° N., reaches the coast of Portugal, after making a curve northward, in about the same latitude. In other words, the surface temperature of the Atlantic between the 43rd and 60th parallels, and the 4th and 32nd meridians is the same as that which is found on the 50th meridian between the 41st and 43rd parallels, where the Gulf Stream and Labrador current meet.

Now let us see what corroborative evidence a chart of average salinity will afford.

The northern portion of the North Atlantic, the southern portion of the Greenland sea, and the part of the Barents Sea which are enclosed by the 35 and 36 isohalines, are filled with water of the same salinity as that which we find in the Gulf Stream between Cape Hatteras and its place of meeting with the current from the north.

Whether the relatively warm saline stream or any part of its waters which flows north-eastward from the region south of the Great Bank is derived from that stream which issues for the most part from the Gulf of Mexico, or, as some aver, is an independent stream which takes its origin in the former locality, is a question which must remain unsettled until the results of further investigations are available. This, at the least, we know, that from the Strait of Florida northward and north-north-eastward to the edge of the Bank; thence north-eastward, as well as eastward, across the ocean, aided, no doubt, by the prevailing westerly and south-westerly winds, there exists throughout the year a continuous flow of warm saline or relatively warm saline water to the north-easterly branch of which these islands owe much of their salubrity.

The salubrity of our climate is, of course, largely due to its comparatively mild and even temperature. The relatively small annual range of temperature that obtains normally results from our insular position; the warmth we owe also in a large measure to the surrounding sea, which receives much of its heat from that ocean stream, the course of which we have been following.

I will endeavour to show you by means of diagrams the somewhat frequent correlation of sea temperature with the air temperature over our islands during the decade 1903–1912. In order to confine within manageable limits that portion of the inquiry which relates to sea-surface temperature, the North Atlantic is represented by a broad zone situated between Florida Strait and Valencia in the south-west of Ireland. It happens that the changes in surface temperature, which may be regarded as of premier importance in this connection, occur in this zone.

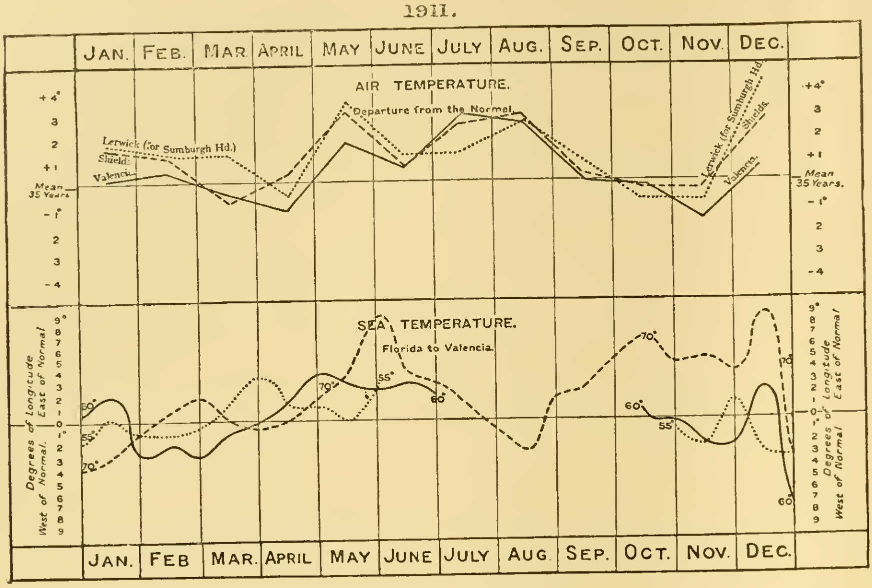
In the diagrams relating to sea temperature in this Florida-Valencia zone, the excess or defect in the surface temperature is expressed by the number of degrees of longitude in which the 70°, 60°, and 55° isotherms are east or west of their average limit for the month.

Air temperature over our islands is represented, roughly it must be admitted, by the temperature

[1] From a lecture delivered before the Royal Geographical Society on May 21, 1914, by Commander M. W. Campbell Hepworth, C.B.

registered at three stations, widely separated: Valencia, Sumburgh Head, in the Shetlands, and North Shields. The curves exhibiting changes in temperature at these places show departures from the normal in degrees Fahrenheit, by reference to the scales above and below a line which represents the average of numerous observations extending over a period of thirty-five years.

1911.

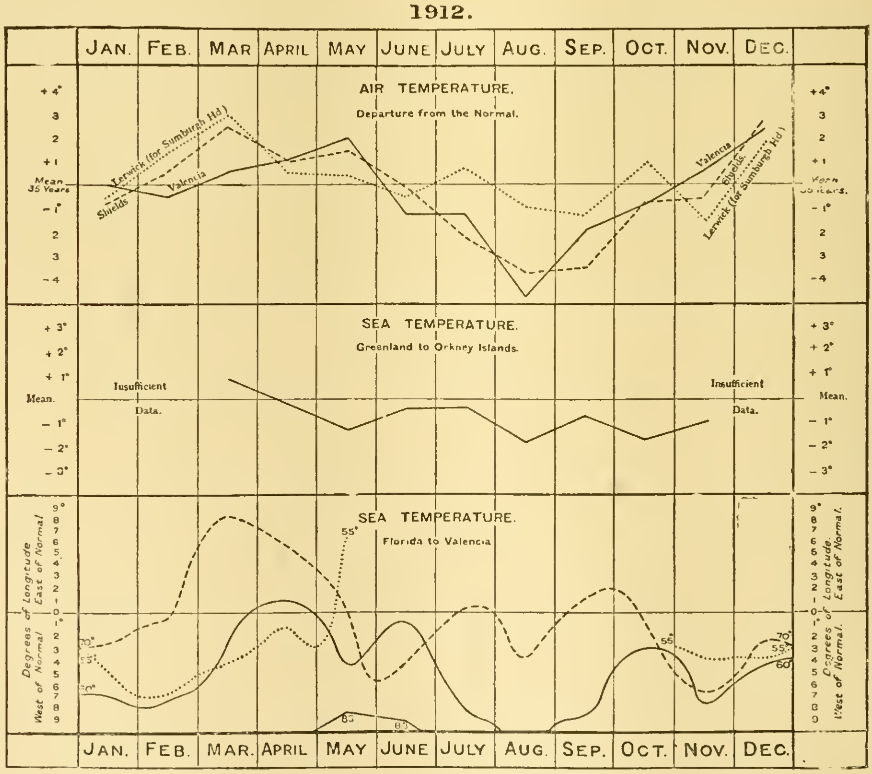


The salient features exhibited in the years 1911 and 1912 are as follows:—

Sea temperature in the northern half of the ocean is shown to have been slightly in excess of the normal in January; but, as indicated by the 70° isotherm, in defect, but increasing, in the southern half. Subsequently it increased to above the normal in the south-western Atlantic until the end of February, and declined to the north-eastward during that month. The conditions were reversed in March, a fall in temperature taking place to the south-west, and a rise to the north-eastward. Over the area represented by the 60° and 70° isotherms temperature rose in April, but declined to the north-eastward. After April sea temperature was in excess of the normal until October, except in the south-west portion of the ocean, when the 70° isotherm retreated to the west of its average limit in August. The temperature in this part, however, quickly recovered, the 70° isotherm, which was nearly 9° of longitude to the east of its average limit at the end of May, again advanced, and was 7° east of it in October, and 9° in December; but retreating rapidly towards the close of the month. Increased activity of the Labrador Current in the two closing months of the year reduced the sea temperature for the most part below the normal in the northern portion of the ocean, although south of the 44th parallel it temporarily rose more than 2° above.

As regards air temperature during the year 1911, in the months of January and February, from the close of April to the close of September, and again in December, the temperature of the air over Great Britain and Ireland was in excess of the average; moreover, during the months of May, July, August, and December it was greatly in excess. In October the temperature was about the same as the average, and in March, April, and November only can it be said to have been in defect.

1912.



Throughout the greater part of the year 1912 the curves of air temperature resemble, in a marked degree, those relating to sea-surface temperature.

Sea Temperature.—The temperature of the sea surface, which fell below the normal at the close of the previous year, continued in defect during the first three months of the year under notice, except in the south-western portion of the North Atlantic, where it rose above the normal after the middle of February. The temperature then increased so quickly that in less than a month the 70° isotherm was charted 8° to the east of its average limit for March. In the more northern portions of the ocean, the surface temperature, although in defect until after March, rose from the middle of February until April, and in that month the charted results exhibited, for the most part, an excess of temperature over the North Atlantic generally. The abnormally warm water, of equatorial origin, that was advancing north-eastward, and had been most noticeable in the south-western Atlantic in March, and between the 40th and 50th parallels of latitude in the following month, reached the north-eastern Atlantic in May, flooding the coastal waters off our southern shores, while a decided reduction of surface temperature was taking place in other parts of the ocean.

At the end of May, and in the beginning of June, the 70° isotherm had retreated 6° to the west of its average limits for those months, but a slight temporary recovery of temperature was observed between the 40th and 50th parallels up to the middle of the latter month, when under the cooling influence of the Labrador Current the surface temperature rapidly declined; the 60° isotherm in August having retreated as much as 13° of longitude to the west of its average limit. In the south-west arm of the ocean the temperature rose during June and July, reaching the average towards the close of the latter month, when it declined, but recovered in September. It again declined during the two months that followed, in the latter of which it became considerably in defect; and, although the sea surface temperature increased in the second half of November, it continued to be below the normal to the end of the year.

To the north-eastward the isotherm of 60°, and subsequently that of 55°, indicated a decided defect in surface temperature to the end of the year: albeit fluctuations are shown which harmonise with the temperature of the surface water to the south-westward, as indicated by the 70° isotherm.

For the zone between South Greenland and the Orkneys sufficient data are wanting for the purpose of comparison with normal results, until March, when the surface temperature is shown to have been slightly above the normal. It declined during the following two months, when it stood $1\frac{1}{2}°$ below the normal; but it rose to, and remained, $\frac{1}{2}°$ below the normal in June and July; fell under the influence of the East Greenland Current in August; recovered somewhat in the month following; and exhibited similar fluctuations as those which obtained in August and September during the two remaining months, for which sufficient data are available.

The air temperature over the British Isles during the summer and autumn of 1912, in contrast with that prevailing during the same seasons of the previous year, is found, therefore, to have been below the normal in June to November inclusive, except at the northern station in July and October and at the south-western station in November, at which places it rose slightly above in the respective months. It was above the normal in February to May inclusive, except at Valencia, when the excess did not obtain until March; equal to, or nearly equal to, the normal in January, and above in December; at Valencia above in November also.

There appears to be no justification for the assumption that important changes have taken place in the circulation of the North Atlantic during historic times. The velocity and volume of the Gulf Stream exhibit modifications that are non-periodic as well as seasonal—modifications that may occur during any month in any year. When the Stream is abnormally active, its resistance to the Labrador current is probably carried farther north than usual, with the result that its north-easterly branch pursues its course in higher latitudes than obtains normally, and its relatively warm saline waters penetrate to the north-westward of their average limits. When, on the other hand, the Gulf Stream is weaker than is usual, according to the season, the converse happens; the north-easterly branch of the Stream commences its new course after its collision with the arctic current, in lower parallels than those in which it commonly starts, and, possibly, the easterly branch is augmented at the expense of the former; so that the influence of the Stream may be restricted in two ways.

In connection with an investigation undertaken at the Meteorological Office, having for its object a comparison of the changes in the strength of the trade winds of the Atlantic[2] with average results, and of changes in the surface temperature of the North Atlantic with normal values, there was found to be some evidence to prove that departures from the average strength of the two trade winds during a series of months, and at times during even so short a period as one month, were roughly reflected in deviations from the normal through the agency of the equatorial current and Gulf Stream in the average distribution of surface temperature in the North Atlantic in the corresponding series of months or month, as the case may be, of the succeeding year, notwithstanding the existence of many other causes affecting the temperature of the surface water, which must tend towards masking the appearance of such connection.

Proof may, therefore, be claimed, resting on a chain of evidence, that many of the climatic changes to which our islands are subject owe their origin to modifications in the trade winds of the Atlantic, communicated through the agency of the equatorial current and its giant offspring the Gulf Stream.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. E. E. Lamplough, of Trinity College, has been appointed an additional demonstrator of chemistry for the five years ending September 30, 1919.

The Special Board for Biology and Geology has approved a grant of 100*l.* from the Balfour Fund, made by the managers to Mr. George Matthai, of Emmanuel College, in aid of his research entitled, "A Revision of the Meandroid Astræidæ."

EDINBURGH.—Important changes are imminent in regard to several of the chairs in the University. At the present moment three chairs are vacant owing to the resignations of Prof. Niecks (music), Prof. Donald Mackinnon (Celtic), and Prof. Geikie (geology). Prof. James Geikie became professor in 1882 in succession to his brother, Sir Archibald Geikie, who was its first occupant. During the last twenty years, since the subject was included in the recognised curricula for degrees in arts and science, it has gained in importance, and attracts every year large numbers of students of pure science and of engineering, agriculture, and forestry. It must assume a still greater importance when the new degree in mining has been

[2] "The Trade Winds of the Atlantic Ocean."

fully established. Prof. Geikie's contributions to the literature of geology are of the highest value, and in his translations of Heine's lyrics he has shown literary gifts in quite another direction. It is believed that, freed from the official duties of a university chair, he will be able to carry out further literary work which he has had in his mind for some years. The filling up of the vacancy created is in the hands of the Crown. The music chair is in the patronage of the University Court, and the chair of Celtic language and literature in the patronage of the curators.

London.—A resolution was adopted by the Senate on June 17 requesting the Vice-Chancellor to inform H.M. Government that the Senate, having considered various sites which have been suggested for the headquarters of the University, is of opinion that it is undesirable to proceed further with such consideration unless, and until, H.M. Treasury intimate its willingness to provide accommodation more suitable in situation, more convenient in character, and on terms not less advantageous as regards tenure, etc., than those attaching to the present occupation at South Kensington.

Official information has been received that the Government cannot contemplate the diversion of Somerset House, which has been suggested as a possible headquarters for the University, from its present purposes.

Prof. A. W. Crossley, F.R.S., has been appointed to the University chair of chemistry, tenable at King's College.

Following the resignation of Prof. J. M. Thomson, Prof. H. Jackson has been appointed head of the chemical department at King's College, with the title of Daniell professor of chemistry in the University.

The D.Sc. degree in chemistry has been granted to Mr. A. J. Ewins, South-Western Polytechnic Institute and Goldsmiths' College; and to Mr. R. T. Colgate, Mr. E. H. Rodd, and Mr. E. E. Walker, of the City and Guilds College; and the D.Sc. degree in botany to Mr. H. F. Wernham, an external student.

At the meeting of the council of the East London College, held on June 22, it was announced that the Court of the Drapers' Company had resolved to defray the cost of the erection and equipment of the new chemical laboratories of the college. The cost will amount to approximately 15,000*l.*, and it is hoped that the laboratories will be available for the use of students at the commencement of the new session in October next.

Dr. H. J. S. Sand, of University College, Nottingham, has been appointed lecturer on chemistry at the Sir John Cass Technical Institute, London, E.C., in succession to the late Dr. Harry Burrows.

At the Convocation of McMaster University, Toronto, held on May 6, the honorary degree of Doctor of Laws was conferred upon Mr. David Hooper, late economic botanist of the Botanical Survey of India, and curator of the industrial section, Indian Museum, Calcutta.

The trustees of the Beit Scientific Research Fellowships, founded and endowed by Mr. Otto Beit, in September, 1913, have elected three fellows for the ensuing year, namely, Mr. R. S. H. Boulding, Mr. L. H. Parker, and Mr. L. N. G. Ramsay. The fellowships are tenable at the Imperial College of Science and Technology, South Kensington. Mr. Boulding is a post-graduate student in engineering at the City and Guilds (Engineering) College, and the joint author of a paper on the shape of the pressure wave in electrical machinery. Mr. Parker is a research student in chemistry at the Imperial College, joint author of a paper on the interaction of sodium amalgam and water, and author of papers on the action of variously treated waters on sodium amalgam, and reactions by trituration. Mr. Ramsay is an assistant in zoology at the University of Aberdeen, and the author of "Note on the Oviposition of Rhyssa," "Polychæta (Nereidæ) of the Scottish National Antarctic Expedition," "Ornithology of the Scottish National Antarctic Expedition," and other papers.

An anonymous donor has made a gift of 10,000*l.* to the general endowment of the Royal Technical College, Glasgow, on condition that another sum of 15,000*l.* is promised within a year. A good beginning is thus made to the endowment of the college for, or towards, research purposes, which are specifically mentioned in the letter announcing the gift, and it is hoped that other benefactors will come forward to increase the funds available for the furtherance of research to such an extent as to place the college in a position in this respect comparable with that of like institutions in the United States and Germany. During the last couple of years, for example, the Massachusetts Institute of Technology has received gifts amounting to more than one and a half million pounds; and the benefactions to university and technical education in the United States reach nearly five million pounds a year. No college completely fulfils its function unless it can make suitable provision for research and retain the services of men and women capable of undertaking it. We hope, therefore, that the sum of 10,000*l.* promised to the Royal Technical College will be a nucleus which will attract to itself many similar gifts until it grows to a substantial sum for the promotion of technical education in its best sense, namely, the creation of new knowledge.

New buildings for the Hartley University College, Southampton, were opened by Lord Haldane on June 20. In the course of his address, Lord Haldane said the four universities in Scotland to which the democracy sends the children have sent out all over the world a large number of young men and a good many young women who have been able to help themselves to the cream because of superior skill in getting at it. The old notion that capital is a monopoly of the few and that the working classes never can get access to it has all gone. The real monopolist is the man who has got a trained brain. It is the workman who is educated who gets the best wages. The new class that is growing up is an educated class, and if the democracy wishes to get its share in the new things that are going, then the democracy will have to take advantage of the chances of education. To insist on equality of opportunity in education is the great way to solve the problem of labour and capital. Later, Lord Haldane said:—"I have never known a town or city develop its university without finding something quite new and different come to it. Places that do that add a cubit to their stature. I am not in the least afraid of the invasion of German arms, but I am very much afraid of the invasion of people who have been trained in the German universities and schools. It is time we woke up if we are to keep the position we hold in commercial supremacy."

As a result of the debate in the House of Commons on Friday last on the report stage of the Children (Employment and School Attendance) Bill, it may fairly be said that Lancashire as represented by its textile industry blocks the way of any advance in respect of measures having for their object the satisfactory education of the children of the nation. It will neither consent to the permissive extension of the school age until fifteen by local authorities, nor to the abolition of by-laws which permit a child to leave school so early as twelve, and in the rural districts even earlier, to work as a half-timer. In view of the factious opposition the Bill has evoked, it is clear that only a Government measure will meet the necessities of the case and provide for the raising of the whole-time school age until the age of fourteen, and for the continued effective education of the pupil on leaving school, and within the normal working hours, until at least the completion of his seventeenth year. Only by measures of this kind can the great expenditure on elementary education be justified and its fruits assured. Nothing short of this will enable the country to maintain its position amongst civilised nations. The remarkable industrial and commercial advance of Germany has been secured under conditions of an extended whole-time school age far beyond those prevailing in this country, together with provisions for continued compulsory education within the normal hours of employment on leaving school up to the age of eighteen, of the most effective character. The measures proposed in the Bill have had the strong support of the Manchester Chamber of Commerce and of the Manchester and Salford Trades and Labour Council, and of experienced educationists and social reformers. No so-called industrial exigencies ought to stand in the way of the welfare of the children.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18.—Sir William Crookes, president, in the chair.—Sir D. **Bruce**, Major A. E. **Hamerton**, Captain D. P. **Watson**, and Lady **Bruce**: (1) Trypanosome diseases of domestic animals in Nyasaland. *Trypanosoma caprae*, Kleine. Part III. —Development in *Glossina morsitans*; (2) trypanosomes found in wild *G. morsitans* and wild game in the "fly-belt" of the Upper Shiré Valley; (3) the food of *G. morsitans*; (4) infectivity of *G. morsitans* in Nyasaland during 1912 and 1913.—Dr. C. W. **Andrews**: A description of the skull and skeleton of a peculiarly modified rupicaprine antelope, *Myotragus balearicus*, Bate. *M. balearicus*, Bate, is a peculiarly modified rupicaprine antelope, remains of which were discovered by Miss D. M. A. Bate in cavern deposits in Majorca and Minorca. The dentition is very remarkable. Instead of having three incisors and a canine on each side of the mandibular symphysis, as is usual in the Bovidæ, the canines and the two outer pairs of incisors are wanting, while the median incisors are enormously enlarged rodent-like teeth, growing from persistent pulps. The premolars are reduced in number and the molars have very high crowns. The feet are remarkable for the shortness and stoutness of the metacarpals and metatarsals, which are quite similar to those of the Takin (Budorcas). The animal seems to have been adapted for climbing on steep crags and cliffs, and probably lived on very hard vegetation.—E. T. **Halnan** and F. H. A. **Marshall**: The relation between the thymus and the generative organs, and the influence of these organs upon growth. With a note by G. U. **Yule**.—H. E. **Roaf**: The vapour pressure hypothesis of contraction of striated muscle. Two objections have been urged against muscular contraction being due to movements of water from one portion of the muscle fibre to another. These are: (1) that an osmotic model of muscle cannot cause a sufficient degree of shortening; and (2) that the movement of water would require a longer time than the muscle takes in contracting. The extent of contraction possible for an osmotic model and the time required for this contraction has been calculated for structures of the dimensions of frog's sartorius. It is found that the extent of contraction can be explained by the osmotic model, and that the time required is less than 0·03 sec., and frog's sartorius requires at least 0·04 sec. for complete contraction.—A. N. **Drury**: The validity of the microchemical test for the oxygen place in tissues. Experiments were made to show that the microchemical test with rongalit white, used by Unna to fix the position of the oxygen place in tissues, could be obtained on a surface entirely free from oxygen. A further extension of the work showed that the condensation of a solute on to a surface is markedly influenced by the previous treatment of, or by the gas condensed on, that surface.—Prof. J. S. **MacDonald**: Man's mechanical efficiency. The rate of heat-production, Q, associated with cycling at a uniform rate but with varied performances of mechanical work, is expressed in the following form, $x+Ey=Q$, where x represents the heat-production associated with the uniform rate of movement, y the rate of work-performance. It is shown that E varies inversely with $W^{2/3}$. It follows that, putting on one side x, the energy-transformation entailed by the movements *per se*, the additional energy-transformation required for any definite rate of work-performance is less the greater the weight, W, of the worker; and the mechanical efficiency measured in this fashion varies directly with $W^{2/3}$. It is also shown, however, that x varies approximately with $W^{3/2}$, and thus that the energy-transformation associated with the mere production of movement is much greater the greater the weight.—Dr. A. **Holt**: The colouring matters in the compound Ascidian, *Diazona violacea*, Savigny.—Prof. W. B. **Bottomley**: Some accessory factors in plant growth and nutrition. Plant growth-stimulating substances are formed in sphagnum peat when it is incubated with a liquid culture of certain aerobic soil bacteria for a fortnight at 24° C. These substances are soluble in water and in alcohol, and are active in very small amounts, two applications of water-extract of 0·18 gram treated peat doubling the size of *Primula malacoides* seedlings over untreated plants in six weeks' time. They appear to be similar to so-called accessory food substances essential for nutrition of growing animals, first studied in connection with the deficiency diseases beri-beri and scurvy. The production of these substances appears to be associated with formation of soluble humates in peat by bacterial action. They are not formed when peat is treated with alkalies. Cultures of *Azotobacter chroococcum* grown with extract of "bacterised" peat gave an increase of 18 milligrams of nitrogen in eight days, whilst extract of chemically-treated peat gave no increased fixation. The active substance is precipitated from aqueous solution of alcoholic extract of "bacterised" peat by phosphotungstic acid, and can be further separated by decomposing with baryta, reprecipitating with silver nitrate and decomposing with hydrogen sulphide. Wheat seedlings in sand culture with Detmer's complete food solution gave an increase of 22·7 per cent. with the phosphotungstic fraction, and 17·7 per cent. with the silver fraction. Water-culture experiments with wheat seedlings in Detmer's solution prepared from pure salts in physiologically pure distilled water showed that these substances are essential for assimilation of inorganic food constituents.—Prof. H. B. **Dixon**, C. **Campbell**, and W. E. **Slater**: A photographic analysis of explosion-flames traversing a magnetic field. The authors have carried out a suggestion made by Sir J. J. Thomson that the explosion-wave in gases should be photographed on a rapidly moving film while it traverses a strong magnetic field, to determine whether the emission of electrons in front of the wave "prepares the way" by ionising the gases. Using a very powerful magnet lent them by Sir E. Rutherford, the authors have photographically analysed the explosion-wave in different mixtures of gases before it enters, while traversing, and as it leaves, the magnetic field. In no case did the magnetic field alter the character or velocity of the flames.

Geological Society, June 10.—Dr. A. Smith Woodward, president, in the chair.—E. B. **Bailey**: The Ballachulish fold near the head of Loch Creran (Argyllshire). The purpose of the present paper is to direct attention to two phenomena strikingly illustrated by the local evidence:—(1) The complexity of the slides affecting the Ballachulish Core, and the correlated (quite exceptional) occurrence of more groups towards the close of the fold, south-east of the River Creran, than towards the gape, north-west of the same; (2) the intense secondary refolding of the Ballachulish Fold, and the resultant sinuous outcrop of the Ballachulish Core.—Dr. Douglas **Mawson**: Geology and glaciation of the Antarctic regions.

Mathematical Society, June 11.—Prof. A. E. H. Love, president, in the chair.—R. H. **Fowler**: A problem of diophantine approximation.—G. H. **Hardy**: Some theorems by Mr. S. Ramanujan.—G. H. **Hardy** and J. E. **Littlewood**: Proof of the general Borel-Tauber theorem.—Prof. E. W. **Hobson**: Theorems relating to functions defined implicitly, with applications to the calculus of variations.—J. G. **Leathem**: The differentiation of a surface-integral at a point of infinity.—R. E. **Powers**: Mersenne's numbers.—J. **Proudman**: Free and forced longitudinal tidal motion in a lake.

DUBLIN.

Royal Irish Academy, May 8.—Dr. R. F. Scharff, vice-president, in the chair.—R. **Southern**: Free-living Nemathelmia, Kinorhyncha, and Chætognatha (in connection with the Clare Island Survey). A large number of new free-living nematoda were described, belonging to the families Anguillulidæ, Desmoscolecidæ, and Chætosomatidæ. One species of Gordius was found on Clare Island. Of the Kinorhyncha (Echinoderes) five species were described, two being new species. Two species of the Chætognatha were found in the plankton of Clew Bay.—J. N. **Halbert**: Acarina (in connection with the Clare Island Survey). In this paper are recorded certain of the terrestrial and marine Acarina collected during the Clare Island Survey. The following families are represented:—Gamasidæ, Oribatidæ, Halaconidæ, and the Trombididæ. Some new species are described, including interesting forms found between tide-marks on the seashore.—G. P. **Farren**: Notes on marine plankton (in connection with Clare Island Survey). The plankton of the Clare Island district is boreal neritic, and may be subdivided into three groups: open-sea plankton, plankton of the intermediate offshore region, and plankton of the bays and harbours. The open-sea is characterised by the comparatively small number of species, a few of which, notably *Calanus helgolandicus*, occur at times in very great abundance. The number of species in the bays and harbours is large, many of them being only temporarily planktonic forms derived from the bottom. The intermediate region contains elements derived from both the other groups, but a few species, *e.g. Aurelia aurita*, find optimum conditions in it.

PARIS.

Academy of Sciences, June 13.—M. P. Appell in the chair.—A. **Haller** and R. **Cornubert**: Syntheses by means of sodium amide. The alkyl*cyclo*pentanones obtained by the addition of hydrogen to unsaturated derivatives. Details of the reduction in presence of nickel as catalyst of dibenzylidene-β-methyl*cyclo*pentanone and βα′-dimethyl-ααα′-triallyl*cyclo*pentanone. The paper concludes with a summary of the results obtained on the substituted *cyclo*pentanones and published in this and preceding communications.—J. **Boussinesq**: The calculation by successive approximation of the continuous velocities in a uniform state by polynomials, in a prismatic tube of square section.—Charles **Richet**: The non-hereditary accommodation of micro-organisms in slightly nutritive media. The lactic bacillus can be grown accustomed to poisons, but becomes weakened by generations of growth in media deficient in food. Such weakened strains supplied with a normal amount of food are still less vigorous than the ordinary strain of bacillus.—M. **Considère**: Measurement of the contraction, strains, the elasticity, and the resistance of the concrete in reinforced concrete constructions.—R. de **Forcrand**: The preparation of the hydrates of manganese sulphate.—V. **Grignard** and Ch. **Courtot**: Derivatives of *cyclo*pentadiene and its dimer. *Cyclo*pentadiene in toluene or petroleum ether solution reacts with magnesium methyl iodide, giving methane and a magnesium compound. The latter compound is very reactive, but the substances obtained are mostly derivatives of the dimeric $C_{10}H_{12}$.—J. **Renaut**: The isochromaticity of the hard segregation grains of rhagiocrine connective cells and the figured collagen formations of the conjunctive tissue.—M. **Angelesco**: A generalisation of Hermite's polynomials.—P. **Appell**: Observations on the preceding communication.—Charles N. **Moore**: The relation between certain methods for the summation of a divergent series.—Leonida **Tonelli**: A direct method in the calculus of variations.—Paul **Renard**: The mode of construction of flexible airships.—Jules **Baillaud**: A simple arrangement for recording rhythmic time signals. A heavy pendulum is arranged to make an electrical circuit, arranged to produce taps in the telephone receiving the wireless signals, and these are brought into exact coincidence by displacing the contact-maker.—M. **Maldiney**: A colour reaction exhibited by solid hydroquinone. Solid hydroquinone and potassium carbonate, rubbed together, give a characteristic blue coloration.—Paul **Jégou**: An arrangement for studying the strength of the oscillations received in wireless telegraphy. An electrolytic detector without any external electromotive force is used in conjunction with a transformer with movable coil. The detector is of low sensibility but high constancy in its indications, and hence is not easily affected by parasitic waves. A series of twelve measurements taken every two hours throughout the day clearly shows the favourable action of darkness on the wave propagation.—Maurice de **Broglie**: Direct spectrum analysis by the secondary Röntgen rays.—R. **Ladenburg** and F. **Reiche**: The distribution of energy in the D lines of sodium.—Daniel **Berthelot**: The various modes of photolysis of oxalic acid by the ultra-violet rays of different wave-length. Solid oxalic acid with ultra-violet rays of middle and very short wave-length gives carbon dioxide and formic acid as the primary products of decomposition, some carbon monoxide and hydrogen being present as secondary products, probably arising from the action of the rays on the formic acid. In aqueous solution the secondary products appear in larger proportion.—F. Léprince **Ringuet**: The limits of inflammability of marsh gas. A study of the influence of moisture, pressure, diameter of the explosion tube, and direction of the explosion (from above or below) on the explosive properties of mixtures of methane and air.—O. **Honigschmid** and Mlle. St. **Horovitz**: The atomic weight of lead from pitchblende. According to recent theories the final disintegration product in the uranium radium series, known as Radium-G, and isotopic with lead, should possess a different atomic weight. The average result of a series of atomic weight determinations carried out on a sample of lead extracted from pitchblende was 206·74, or 0·4 less than the atomic weight of ordinary lead. This figure confirms the theoretical indications.—E. **Berger**: The reduction by hydrogen of the oxides of copper and nickel in presence of a dehydrating agent. The reduction of these oxides is strongly accelerated when the water vapour is removed as fast as it is formed. The reduction of copper oxide is continuous, but there are indications of the existence of a nickelous oxide, Ni_2O.—Jacques **Joannis**: The oxidation and reduction of copper.—L. **Gay**, F. **Ducellier**, and A. **Raynaud**: The bromination of benzene and its homologues. The catalytic action of manganese. Metallic manganese exerts a marked accelerating action in the bromination of benzene and toluene. If the reagents are dry the metal is unchanged.—Marcel **Godchot**: Thujone and thujamenthone. The direct passage from one to the other. Thujone and hydrogen in the presence of nickel give a good yield of thujamenthone.—Léo **Vignon**: The synthetic preparation of a coal gas. A scheme for the conversion of a mixture of coal gas and water gas, or water gas alone, into a gas possessing approximately the heating value of ordinary coal gas and free from carbon monoxide. It is based on the use of lime, nickel, and other catalytic agents.—Georges **Friedel**: A layer of iodargyrite in France. This rare mineral has been found in cavities in a vein of campylite at Les Montmans, near Echassières. G. **André**: The velocity of hydrolysis and of displacement by water of the nitrogenous and mineral materials contained in leaves.—Charles **Nicolle** and Georges **Blanc**: Are the spirillæ of recurrent fever virulent during the successive stages of their evolution in the flea? Demonstration of their virulence at an invisible stage.—J. E. **Abelous** and C. **Soula**: Modifications of the cerebral action in anaphylaxy. An experimental study in the changes in the cerebral metabolism resulting from the injection of a non-fatal dose of urohypotensine.—Auguste **Lumière** and Jean **Chevrotier**: The vitality of cultures of gonococcus. It would appear from the experiments described that the poisonous substance to which the rapid sterilisation of gonococcus cultures is due is an oxidation product of the exotoxines secreted by the organism. Consequently by working under anaerobic conditions the vitality of gonococcus cultures can be increased.—Louis **Roule**: The deep-water fishes belonging to the family of the Eurypharyngideæ.—Gabriel **Bertrand** and M. **Rosenblatt**: The thermo-regeneration of the various diastases of yeast.—S. **Sécerov**: The influence of ultra-violet light on the coloration of the fur of rabbits and guinea-pigs. The white fur of these animals becomes yellow or reddish under the action of ultra-violet light.—H. **Bierry** and Mlle. Z. **Gruzewska**: The estimation of sugar materials in the liver.—M. de **Lamothe**: The ancient alluvial sheets and terraces of the Rhône and Isère, near Valence.—G. **Gardet**: New fossiliferous horizons in the upper Muschelkalk in the neighbourhood of Bourbonne-les-Bains.—M. de Montessus de **Ballore**: The probable epirogenic origin of earthquakes in New Zealand.

BOOKS RECEIVED.

Canada. Department of Mines. Geological Survey Branch. Memoir 31: Wheaton District, Yukon Territory. By D. D. Cairnes. Pp. x+153. Memoir 43, No. 36, Geological Series: St. Hilaire (Beloeil) and Rougemont Mountains, Quebec. By J. J. O'Neill. Pp. vi+108. Memoir 52, No. 42, Geological Series: Geological Notes to accompany Map of Sheep River Gas and Oil Field, Alberta. By D. B. Dowling. Pp. ii+26. (Ottawa: Government Printing Bureau.)

Beiträge zur Naturdenkmalpflege. Band iv., Heft 2. Ueber den Schutz der Natur Spitsbergens. By H. Conwentz. Pp. 65–138. (Berlin: Gebrüder Borntraeger.)

Odontologische Studien II. Die Morphogenie der Primatenzähne. By Prof. L. Bolk. Pp. viii+181. (Jena: G. Fischer.) 7 marks.

Philosophical Transactions of the Royal Society of London. Series B., Vol. 205: Some Notes on Soil Protozoa. By C. H. Martin and K. R. Lewin. Pp. 77–94. (London: Royal Society.)

The Leather Trades' Year Book. Edited by M. C. Lamb and J. G. Parker. Pp. 210. (London: Anglo-American Technical Co., Ltd.) 3*s*.

Storied Windows. By A. J. de H. Bushnell. Pp. xi+338+plates. (Edinburgh and London: W. Blackwood and Sons.) 15*s*. net.

Morocco the Piquant. By G. E. Holt. Pp. xi+242. (London: W. Heinemann.) 6*s*. net.

A Natural History of Bournemouth and District. By the Members of the Bournemouth Natural History Society. Edited by Sir D. Morris. Pp. xiv+400. (Bournemouth: The Natural Science Society.) 2*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma: Orthoptera (Acridiidæ). By W. F. Kirby. Pp. ix+276. (London: Taylor and Francis.) 10*s*.

Simplification Studies. I.: Stellar Aberration. Part i. By M. Niles. Pp. 100. (Brunswick, Maine: Brunswick Publishing Co.)

The Theory of Relativity. By Dr. L. Silberstein. Pp. viii+295. (London: Macmillan and Co., Ltd.) 10*s*. net.

A First School Calculus. By R. Wyke Bayliss. Pp. xii+288. (London: E. Arnold.) 4*s*. 6*d*.

Berichte der Naturforschenden Gesellschaft zu Freiburg i Br. Zwanzigster Band 1913 u. 1914. Heft 2. Edited by Prof. W. Schleip. Pp. v+182. (Naumburg.)

Livingstone College Year Book, 1914. Pp. 136. (Leyton: Livingstone College.)

Board of Agriculture and Fisheries. Fishery Investigations. Series II. Sea Fisheries. Vol. i., Part i., Report on Market Measurements in relation to the English Haddock Fishery during the years 1909–1911. Pp. iv+133. (London: H.M.S.O., Wyman and Son, Ltd.) 4*s*. 6*d*.

The Romanes Lecture, 1914. The Atomic Theory. By Sir J. J. Thomson. Pp. 39. (Oxford: Clarendon Press.) 1*s*. 6*d*. net.

Roger Bacon: Essays contributed by various writers on the occasion of the Commemoration of the Seventh Centenary of his Birth, collected and edited by A. G. Little. Pp. viii+426. (Oxford: Clarendon Press.) 16*s*. net.

Der Säugetierorganismus und seine Leistungen. By Prof. E. T. v. Brucke. Erster Teil. Pp. 192+plates. Zweiter Teil. Pp. 173. (Leipzig: P. Reclam, jun.) Two parts in one volume. 1.75 marks.

The Unconscious. By Prof. M. Prince. Pp. xii+549. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

The Essence of Astronomy. By E. W. Price. Pp. xiv+207. (New York and London: G. P. Putnam's Sons.) 10*s*. 6*d*. net.

Studies in Economic and Political Science. Edited by Hon. W. Pember Reeves. Kinship and Social Organisation. By Dr. W. H. R. Rivers. Pp. vii+96. (London: Constable and Co., Ltd.) 2*s*. 6*d*. net.

Studien in der Geophysik und der Kosmischen Physik. By O. Pettersson. Pp. 31. (Berlin: E. S. Mittler und Sohn.)

Ancient Egypt. By Prof. E. J. Rapson. Pp. viii+199. (Cambridge: University Press.) 3*s*. net.

Smithsonian Institution. U.S. National Museum. Bulletin of the U.S. National Museum. No. 50, The Birds of North and Middle America. Part vi. By

R. Ridgway. Pp. xx+882+xxxvi plates. (Washington: Government Printing Office.)

University of Pennsylvania. The Museum Anthropological Publications. Vol. iii. No. 3. Excavations in Eastern Crete · Vrokastro. By E. H. Hall. Pp. 75–185+plates xvii–xxxv. (Philadelphia: University Museum.)

Smithsonian Institution. U.S. National Museum. Bulletin 84. A Contribution to the Study of Ophiurans of the United States National Museum. By Prof. R. Kœhler. Pp. vii+173. (Washington: Government Printing Office.)

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. xi. Pp. ix+437. (London: Institute of Metals.) 21*s.* net.

International Meteorological Committee. Report of the Tenth Meeting, Rome, 1913. Pp. 98. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s.*

Les Coordonnées intrinsèques Theorie et Applications. By Dr. L. Braude. Pp. 100. (Paris: Gauthier-Villars et Cie.)

An Introduction to the Study of Organic Chemistry. By Dr. H. T. Clarke. Pp. viii+484. (London: Longmans and Co.) 6*s.* 6*d.*

The Theory of the Solid State. By Prof. W. Nernst. Pp. viii+104. (London: Hodder and Stoughton.) 2*s.* 6*d.* net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xiv. (London: W. Wesley and Son.) 3*s.* 6*d.*

Australasian Fossils. By F. Chapman. Pp. 341 and map. (Melbourne: George Robertson and Co., Ltd.; London: Dulau and Co., Ltd.) 7*s.* 6*d.* net.

Die Pendulations-Theorie. By Prof. H. Simroth. Zweite Auflage. Pp. xv+597. (Berlin: K. Grethlein.)

Naturwissenschaftliche Bibliothek für Jugend und Volk: Vulkane und Erdbeben. By Prof. R. Brauns. Pp. vi+168. Aus Seen und Bächen die niedere Tierweldt unserer Gewässer. By Dr. G. Ulmer. Pp. ix+149. Der deutsche Obstbau. By F. Meyer. Pp. v+207. (Leipzig: Quelle und Meyer.) 1.80 marks each.

The Life and Work of Roger Bacon: An Introduction to the Opus Majus. By J. H. Bridges. Edited, with Additional Notes and Tables, by H. G. Jones. (London: Williams and Norgate.) 3*s.* net.

The Beginner's Garden Book. By A. French. Pp. viii+402. (London: Macmillan and Co., Ltd.) 4*s.* 6*d.* net.

Native Tribes of the Northern Territory of Australia. By Prof. Baldwin Spencer. Pp. xx+516. (London: Macmillan and Co., Ltd.) 21*s.* net.

Greek Philosophy. Part i. Thales to Plato. By J. Burnet. Pp. x+360. (London: Macmillan and Co., Ltd.) 10*s.* net.

The British Empire Beyond the Seas. By Dr. M. I. Newbigin. Pp. xii+351. (London: G. Bell and Sons, Ltd.) 3*s.* 6*d.*

The Future of Education. By F. C. C. Egerton. Pp. 303. (London: G. Bell and Sons, Ltd.) 3*s.* 6*d.* net.

An Introduction to Celestial Mechanics. By Prof. F. R. Moulton. Second edition. Pp. xvi+437. (London: Macmillan and Co., Ltd.) 15*s.* net.

The Rose of the Winds: the Origin and Development of the Compass-Card. By Prof. S. P. Thompson. Pp. 31+6 plates. (London: H. Milford.) 4*s.* net.

A New Analysis of Plane Geometry, Finite and Differential. By A. W. H. Thompson. Pp. xvi+120. (Cambridge University Press.) 7*s.* net.

Bird Studies. By W. P. Westell. Pp. xii+152. (Cambridge University Press.) 2*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 25.

ROYAL SOCIETY, at 4.30.—The Spectrum of Elementary Silicon: Sir W. Crookes.—Note on Mr. Mallock's Observations on Intermittent Vision: Prof. S. P. Thompson.—Attempts to Produce the Rare Gases by Electric Discharge: T. R. Merton.—The Analysis of Gases after Passage of Electric Discharges: O. C. G. Egerton.—Dilute Solutions of Aluminium in Gold: C. T. Heycock and F. H. Neville.—The Variation of Electrical Potential across a Semipermeable Membrane: Prof. F. G. Donnan and G. M. Green.—The Potential of Ellipsoidal Bodies and the Figures of Equilibrium of Rotating Liquid Masses: J. H. Jeans.—The Twenty-seven-Day Period in Magnetic Phenomena: Dr. C. Chree.—Electrification of Water by Splashing and Spraying: J. J. Nolan.—Effect of Pressure upon Arc Spectra. V.: W. G. Duffield.—Measurement of Alternating Electric Current of High Frequency: A. Campbell and D. W. Dye.—*And other Papers.*

FRIDAY, JUNE 26.

PHYSICAL SOCIETY, at 5.—Atmospheric Refraction and its Bearing on the Transmission of Electromagnetic Waves Round the Earth's Surface: Prof. J. A. Fleming.—Atmospheric Electricity Observations made at Kew Observatory: G. Dobson.—Thermal and Electrical Conductivities of some of the Rarer Metals and Alloys: T. Barratt.—The Measurement of the Temperature Coefficient of Young's Modulus for Metallic Wires, with Special Application to Nickel: Prof. E. P. Harrison.—Some Investigations on the Arc as a Generator of High Frequency Oscillations: F. Mercer.

THURSDAY, JULY 2.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lithological Map of the British Isles: Alan G. Ogilvie.

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THURSDAY, JULY 2, 1914.

ORIGIN OF IGNEOUS ROCKS.

Igneous Rocks and their Origin. By Prof. R. A. Daly. Pp. xxii + 563. (London: Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., Inc., 1914.) Price 17*s*. net.

PROF. DALY is a man of ideas. A few facts observed in the field suggest to him a hypothesis which he then proceeds to test by searching for other facts which must exist if the hypothesis be of any value for scientific purposes. He is perhaps most widely known as the author who, more than any other, has developed the theory of "magmatic stoping." Large masses of plutonic rock—such, for example, as the granites of Devon and Cornwall—can be proved by field evidence to fill spaces that must formerly have been occupied by other rocks. In the case referred to the displaced rocks consisted largely of folded sediments. What has become of them? According to the theory in question, the roof of the magmatic chamber has been shattered, and the detached fragments have in general sunk in the rising plutonic magma. This theory is explained and illustrated in the present volume, and much use is made of one of its probable consequences—namely, the development of secondary magmas by "syntexis"; or, in other words, by the solution in the rising magma of the masses detached from the walls and roof of the magma chamber. This action is believed to account directly or indirectly for many varieties of igneous rock.

But the theory of magmatic stoping is only a subsidiary feature of the work. Its main object is to explain the known facts of igneous geology by a few general assumptions as to the composition, structure, and physical condition of the planet, and whatever view is taken as to the validity of the assumptions, there can be no doubt that in working out their consequences the author has produced a most interesting work, full of information on the present-day aspects of igneous geology, and eminently calculated to stimulate thought.

The book is divided into three parts. The first deals with the composition and mode of occurrence of igneous rocks, the relative abundance of the different types at the surface of the earth, and the phenomena of active volcanoes. Rosenbusch's classification is adopted with slight modifications. The classification based on the "norm" is discarded as being useless for the object which the author has in view. The second part deals with abyssal injection, magmatic stoping, assimilation, and differentiation, the mechanism of volcanic vents, and concludes with a statement of what the author terms an *eclectic* theory of igneous rocks. By the term *eclectic* he means to imply that in framing the theory he has selected and appropriated whatever seemed to him best in the earlier theories relating to the same subject. The third part is devoted to applying the general theory to igneous rocks, which, for this purpose, are divided into seven great groups or clans: the gabbro-clan, the granite-clan, the diorite-clan, the granodiorite-clan, the syenite-clan, the alkaline-clans, and the peridotite-clan (including magmatic ores).

The eclectic theory may be briefly summarised as follows:—The earth, regarded as a planet, is roughly stratified according to density, but the three outer shells are alone involved in the production of the igneous phenomena with which geologists have to deal. The outer shell is composed of sediments, with an admixture of volcanic material, and is discontinuous. The second shell, represented by the Canadian and Fennoscandian "shields," approximates to granite in composition. It is probably continuous under continental areas, but may not be present under all the oceanic areas. These two shells collectively form the "crust" of the earth. Beneath them is a third shell or substratum of basaltic composition which alone, "since an early pre-Cambrian period (typified in the Keewatin) has been not enough for spontaneous eruption." It may be discontinuous, but, if so, parts of it underlie both oceanic and continental areas. Abyssal injection implies the rise of the material of the substratum in magmatic wedges which are superheated at the higher levels and therefore capable of dissolving the rocks of the crust to a variable but large extent. Both the primary basaltic magma and each of its solutions with crust-rocks are subject in certain conditions to magmatic differentiation, this giving rise to various magmas by the freezing of which the different types of igneous rock have been produced. A few illustrations of the way in which the author applies the theory will now be given.

The composition of the primary basaltic magma is regarded as that of a basalt containing only a moderate amount of olivine. From such a magma basalts and gabbros rich and poor in olivine may be derived by gravitative differentiation to which the author attaches great importance. Peridotites and anorthosites may be regarded as the extreme phases of the differentiation of the primary magma. Quartz-basalts and related rocks which are now known to be widely distributed in continental areas, though apparently absent from oceanic areas, probably owe their origin to the

T

slight acidification of the primary magma through the solution of siliceous crust-rocks.

In discussing the origin of the rocks forming the granitic clan, the author describes at considerable length cases in which granites are found in association with thick intrusive sheets or sills of basalt or gabbro. Thus the Purcell sills of British Columbia, which vary in thickness from 100 ft. or less to about 1500 ft., are intrusive in thick felspathic and micaceous quartzites of Cambrian or earlier date. In several instances the top of a sheet consists "of a true biotite-granite (rarely hornblendic) passing downward into hornblendic gabbro." Inclusions of quartzite surrounded by syntectic material occur in the gabbro, and the author maintains that the granite of these sills is the gravitative differentiate of a quartzite-gabbro syntectic. The post-Cambrian batholithic granites are supposed to have been formed in a somewhat similar way. They are regarded as differentiates of crust-material dissolved in large abyssal wedges injected from the basaltic substratum. The author, however, hesitates to extend his theory to all the large pre-Cambrian batholiths, and suggests that some of these may be re-fused portions of a primitive crust of granitic composition, the necessary heat having been supplied by radio-activity. Although he refers more than once to radio-activity, this is the only case in which he appears to regard it with any degree of favour as a source of the thermal energy manifested in igneous action.

The origin of each of the other clans is discussed at length, and the chapter dealing with alkaline rocks which are regarded as differentiates of syntectics of primary basalt and carbonates is of special interest. The concluding chapter deals with the application of the general theory to the igneous phenomena of the North American Cordillera.

The book represents an interesting attempt to solve a problem of great complexity with the aid of our present knowledge, which is probably quite insufficient for the purpose.

INTRODUCTIONS TO NATURAL SCIENCE.

(1) *The Realm of Nature. An Outline of Physiography.* By Dr. H. R. Mill. Second Edition, largely re-written. Pp. xii+404. (London: John Murray, 1913.) Price 5*s.*

(2) *Introduction to Biology. An Elementary Textbook and Laboratory Guide.* By Prof. M. A. Bigelow and Anna N. Bigelow. Pp. ix+424. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s.*

(3) *Botany.* By Prof. E. Brucker. Pp. xv+185. (London: Constable and Co., Ltd., 1913.) Price 2*s.* net.

(4) *A First Book of Nature Study.* By E. Stenhouse. Pp. 148. (London: Macmillan and Co., Ltd., 1913.) Price 1*s.* 6*d.*

(5) *Weeds. Simple Lessons for Children.* By R. L. Praeger. With illustrations by S. Rosamond Praeger and R. J. Welch. Pp. x+108. (Cambridge University Press, 1913.) Price 1*s.* 6*d.* net.

(6) *Notes on the Natural History of Common British Animals and some of their Foreign Relations. Vertebrates.* By Kate M. Hall. Pp. xii+289. (London: Adlard and Son, 1913.) Price 3*s.* 6*d.* net.

(1) SINCE 1891 Dr. Mill's "Realm of Nature" has been well known as one of the very best introductions to the study of the physical aspects of the world we live in. Along with a few other books, such as Huxley's "Physiography," it has occupied the first rank among text-books, and that place this new edition will retain. The reasons for this are to be found in the author's quite remarkable clearness of head and style (which everyone who has heard him lecture has admired and envied), in his competence to deal with the many sides of the synoptic science of physiography, and also, we think, in the success with which he has made his facts illustrate principles. The book deals with the earth, the atmosphere, climate, weather, the ocean, the action of water on the land, the record of the rocks, the continents, the distribution of organisms, and man in nature. It has been thoroughly revised and brought up to date, but we are relieved to find that it remains in essence as we have known it for nearly a quarter of a century with the same grip and terseness, the same absence of loose ends and dark corners—along certain lines one of the most educative books we have read. Though in a new dress it is an old friend, and we may be allowed with heartiness to wish it and its author well.

(2) The introduction to biology proposed by Prof. Maurice A. Bigelow and Anna N. Bigelow is one which the authors have tested and found serviceable. It is an introduction to biological facts and ideas, and it is distinctive in selecting those facts and ideas which have a direct bearing on daily life. Thus we find much attention paid to the structure and functions of the human body, the biology of personal hygiene, organisms that affect human health, the economic relations of organisms, the reproduction of organisms, and so on. To our thinking, this is a partial introduction

to biology, but the authors know this as well as we do; they have chosen their path and their book has a strong character of its own, which is more than can be said of many. We have previously referred to the "Teachers' Manual" by the same authors, and we see that there is another companion volume entitled "Applied Biology."

(3) We referred some time ago to Prof. E. Brucker's "Zoology" in the "Threshold of Science" series, and now we have his "Botany." Its conspicuous features are the simplicity of the style, the experimental introduction to the life of the plant, and the way in which the reader is led on from one cohort of natural orders to another. Referring plants to their natural orders is an educative discipline of sorts, but it seems to us to occupy far too large a part of this introductory book. There are many English introductions to the study of botany, and we do not see any reason why this translation should have been added to the list. A new introduction, to justify itself, should be in some way fresh and distinctive. The simplicity that we have alluded to does not always come off, as we may show by a couple of sentences:—"Once they have developed, even very dissimilar living things appear the more alike the younger the states at which they are compared," and "Algæ, mushrooms, bacteria and lichens form the four classes of the *type of algae.*" We protest against two of the lesson titles—"Beginnings of Philosophy" and "Philosophical Considerations Again." Needless to say, there is no philosophy in the lessons, nor should there be. The book is well illustrated.

(4) If a book of nature-study is to be used by junior pupils, which seems to us, in most cases, undesirable, Mr. Stenhouse's can be recommended as one of the best of its kind. It is simply and clearly written, and it is not much too informative. It prompts inquiry, not only in its questions and practical work, but also in its style; and this is a great virtue. The subjects dealt with are common British mammals, plants as food-makers, flowers and fruits and common trees, pond-life, burrowing animals, flying animals, the work of a river, and common stones and fossils. Mr. Stenhouse shows his good sense in keeping, on the whole, to common things and to phenomena which can be readily verified.

(5) Those who are never tired of criticising the modern efforts to lead school children into an intelligent and appreciative acquaintance with the world round about them should take account of a book like Mr. R. Lloyd Praeger's "Weeds," which appears to us very educative—in the truest sense—for the teacher. And happily it does not stand alone. Those teachers who wish to make themselves at home with some good subjects for nature study would do well to take a leaf from Mr. Lloyd Praeger's book. The root-idea is here, and the stem and its leaves and flowers are here too; for the author has shown that in the study of "weeds," which are always with us, you can get the brain-stretching discipline of precision, the mind-awakening appreciation of fitnesses, the naturalist's vision of inter-relations in the web of life, and more besides. The book is uncommonly well done, but it is for teachers—especially for teachers with a way with them. For children it is much too difficult; it is not in the right key. It might become a holy terror.

(6) Miss Kate M. Hall has written a useful and often skilful introduction to mammals, especially British mammals; but she should not have allowed her "good publisher" or herself to entitle the book externally—"Common British Animals." Mammals, to which the book is quite legitimately restricted, form a very small proportion of common British animals; so the title and title-page are quite misleading. Miss Hall knows how to teach, and we find on many a page an educative lesson; but too often this gift has been smothered in very interesting information. We think that a series of somewhat simpler studies on British mammals would have made a more effective book. But we recognise that part of the idea was to compare British with foreign forms.

CHEMISTRY OF PLANTS.

(1) *Untersuchungen über Chlorophyll. Methoden und Ergebnisse.* By Richard Willstätter and Arthur Stoll. Pp. viii + 424 + xi plates. (Berlin: Julius Springer, 1913.) Price 18 marks.

(2) *Biochemie der Pflanzen.* By Prof. Friedrich Czapek. Zweite umgearbeitete Auflage. Erster Band. Pp. xix + 828. (Jena: Gustav Fischer, 1913.) Price 24 marks.

(1) THE paper cover in which the former of the above books is issued contains advertisements of the monographs by Emil Fischer on the amino-acids and proteins, on the purine substances, and on the carbohydrates, which are issued by the same publisher. The book of Willstätter and Stoll under review is a worthy successor of these classical works, and will be extremely welcome to all who have followed the publications during the last eight years of the researches of Willstätter and his pupils in Liebig's *Annalen*; they will be especially grateful for the full experimental details given in the description of the various preparations.

The monograph is not merely a reprint of the numerous papers from Liebig's *Annalen*, but starts, in the first chapter, with a useful summary of all the results obtained up to the date of issue, and the relationship of the various substances isolated during the course of the researches is clearly indicated in tabular form. The book concludes with a description of some researches, most of which receive their first publication in this volume, on the pigments of the blood and their derivatives, and throw further light on the chemical relationship between the green pigment of plants and the red pigment of the blood, amplifying in a striking manner the earlier investigations of Hoppe-Seyler, Schunck, Nencki, and others.

It is difficult to select from such a mass of new material points for special mention in a short review. As an example, however, of the immense amount of patience and skill required in the preparation of chemically-pure preparations, the separation of chlorophyll into its components *a* and *b*, described on p. 163 *et seq.* may be cited; to obtain only a preliminary separation of the two substances contained in 8 grams of a mixture, no fewer than fourteen extractions of the solution in light petroleum with methyl alcohol were required, and 2 litres of the alcohol were employed for each extraction. Experimental details of this character are of interest, in that they illustrate the great technical difficulties of modern biochemical research, and the necessity of a somewhat costly equipment for laboratories devoted to this object; it is doubtful, indeed, whether the talent of a Willstätter would have availed in accomplishing what is described in this monograph, had there not been, in the first place, ample funds for the supply of the necessary material and apparatus, and in the second place, the cooperation of several accomplished students. The book contains many other examples of brilliant experimental technique, and for this reason alone it is well worthy of perusal by all chemists whose work entails large-scale laboratory operations.

Of the results of scientific interest, attention may, in the first place, be directed to the confirmation of the statement of Stokes, published in 1864, based on spectroscopic examination, that the chlorophyll of land-plants contains no fewer than four pigments. To this investigator and to Kraus and Sorby are due the principles of the method which, in the hands of Willstätter and his pupils, has finally led to the isolation of all the four pigments in a chemically-pure form.

Of great interest also, is the discovery of the fact that magnesium is an essential part of the chlorophyll molecule, just as iron forms an integral part of the molecule of the blood-pigment. No less interesting is the discovery of the alcohol, phytol, and of the enzyme phytase, an example of a new species of ferment capable of acting in alcoholic solutions. Mention must also be made of the mysterious change, designated by Willstätter "allomerisation," which takes place, apparently under the influence of some catalyst in alcoholic solution the exact nature of which has not yet been explained.

Although the results so far obtained do not warrant the assignment of a definite formula to the two chlorophylls, the general character of these pigments and of hæmin appears to be fairly well established. The recent valuable work of Piloty, Hans Fischer, and others on the synthesis of various pyrrole derivatives has also materially aided in the elucidation of the complex formulæ of these pigments. It is to be hoped that the publication of the researches on chlorophyll in their present form will afford a stimulus to research on plant physiology. The vexed question as to the mechanism of the sugar synthesis in the presence of chlorophyll still remains unsolved, and the fact that it is now possible to obtain the separate pigments of the leaf free from all contaminations should materially assist in the solution of this problem. Certain interesting suggestions as to the relationship of the pigments to one another, and as to their biological functions, are made in this monograph, which opens great vistas of future research.

(2) It is now nine years since the first edition of Prof. Czapek's two bulky volumes on the general chemistry of plants was issued, and it may be regarded as a favourable sign that a complete new edition of a work of this magnitude should be called for so soon. The first 240 pages of the present issue deal chiefly with general biological problems, including those relating to the physical structure of the cell, a subject which has received much attention from plant physiologists in recent times as a result largely of Prof. Czapek's own researches. The remainder of the volume is devoted to the special biochemistry of the sugars, fats, and lipoids, which are treated both from the more purely chemical and the physiological point of view. Books of reference of this description are indispensable nowadays to workers on biological chemistry, when the results of recent investigations are dispersed amongst so many journals. We owe, therefore, a great debt of gratitude to Prof. Czapek for his labours in collecting together a heterogeneous mass of material and issuing it in a form in which it can be readily reviewed.

S. B. S.

OUR BOOKSHELF.

A Junior Geography of the World. By B. C. Wallis. Pp. x + 310 + maps. (London: Macmillan and Co., Ltd., 1913.) Price 2s. 6d.

THIS book possesses many merits; its language is always clear, its accuracy, so far as can be judged, unimpeachable. It is arranged on the plan of a long introductory section dealing with the principles of geography, followed by a treatment of the continents in detail, in which the order followed is the unusual (and not obviously advantageous) one of Australia, Africa, the Americas, Asia, Europe. A final separate section deals with the British Isles. The volume is entitled a junior geography, but, to juniors, parts of it (such as that on map-making, or some of the sections which deal with the quantitative analysis of products) may be found difficult; while, excellent as the geographical principle of regional comparison is, it is open to question whether it should be followed from the very beginning. In this department, the text possibly tends to be overweighted with examples. Each section contains a number of questions, in many cases based upon examination questions selected with great care from a wide range of papers.

The illustrations, whether maps, diagrams, or pictures, are clear and good, but we cannot conceive that the extremely small type employed is justifiable on any standard. The index is remarkable. It is stated to be "intentionally short"; in point of fact, it contains about sixty references under eight headings, and the student is charged to make a full index for himself on the lines indicated. Is modern educational practice to demand of the student that he should index all his text-books?

Hereditary Genius: An Inquiry into its Laws and Consequences. By F. Galton. New edition. Pp. xxix + 379. (London: Macmillan and Co., Ltd., 1914.) Price 5s. net.

"HEREDITARY GENIUS" was first published in 1869 and comes second in the series of works in which Galton's investigations on inheritance were given to the public, being preceded in 1865 by the papers in "Hereditary Talent and Character" which appeared in *Macmillan's Magazine*. A second edition appeared in 1892 from which the present issue has been reprinted. That after forty-five years there should still be a demand for this book is no source of wonder. It is the work of a master and for that reason one shrinks from praising it. But coming back to it after an interval one is struck again by its freshness, its readableness, and the wealth of apt comparison with which it is illustrated. Of the social significance of the subject it is also needless to speak. As Galton shows it bears on most things of interest to the human race from the doctrine of original sin to the vigorous growth of new colonies, and it led him in the last chapter to express views on individuality and the place of the individual in the living universe, which seem to be echoed in much modern sociological teaching on the subject.

The publishers have earned our gratitude in again making this book available, but it is to be regretted that economy in the matter of margin has given the printed pages a rather unattractive appearance.

The Engineering Index Annual for 1913. Pp. 508. (New York: The Engineering Magazine Co., 1914.) Price 2.00 dollars.

THIS volume of the Engineering Index is the twelfth since the work first appeared and is the eighth since the appearance of annual issues. It comprises the monthly instalments published in 1913 in the *Engineering Magazine* and covers the field of serial literature in engineering up to October, 1913. The purpose of the volume is to aid the searcher for information on any specific subject connected with engineering to obtain quickly the names and dates of issue of periodicals, etc., containing articles dealing with the subject. The matter is classified under the main headings of civil engineering, electrical engineering, industrial economy, marine and naval engineering, mechanical engineering, mining and metallurgy, railway engineering, and street and electric railways. These again are subdivided into sections, thus facilitating the process of obtaining all published information on any given subject. Each reference gives, in addition to the name and date of the periodical, a brief summary of the contents of the article or paper, sufficient in most cases to enable the searcher to decide whether it is worth while to pursue his inquiries further. Owing to the great mass of engineering matter published annually throughout the world, the need for such a volume is evident, and the present work can be recommended as a successful attempt to give a concise and complete index of last year's publications.

Routledge's New Dictionary of the English Language. Edited by C. Weatherby. Pp. viii + 1039. (London: George Routledge and Sons, Ltd., 1914.) Price 3s. 6d.

THIS attractively produced dictionary claims to include all the principal new scientific, technical, industrial, sporting, colloquial, slang, and other words, both English and American, as well as pronunciations and etymologies. Prolonged use alone enables one to pronounce judgment on a dictionary; but it may be said that this has answered successfully numerous test appeals made to it.

Nature in Books. A Literary Introduction to Natural Science. By J. L. Robertson. Pp. 156. (Oxford: The University Press, 1914.) Price 2s.

THE primary object of this little book is to kindle in young readers an interest in, and love for, Nature and her works. The author's idea is to lead pupils from the descriptions of Nature by our great writers to the world of wonder itself. We echo his hope that the book will take many of its readers to "the open," and that there they may become open-eyed and intelligent first-hand observers.

LETTERS TO THE EDITOR.

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

The Principle of Relativity

In reading through Mr. Cunningham's article on "The Principle of Relativity," I have been struck by several points which seem to require some elucidation. Whether these difficulties are inherent in the "principle of relativity" as it is generally understood, or whether it is merely owing to the fact that for some time I have been accustomed to look at the matter from a different point of view, which I believe solves these difficulties, and that, on this account, I am rather obtuse towards other views, I cannot say.

Some of these points may be best indicated by Mr. Cunningham's own words, as follows:—

(1) "Now the very first thing that appears, if we accept the hypothesis of relativity, is that it is impossible for us to determine uniquely whether two events are or are not simultaneous."

(2) "We find that the conception of 'simultaneity' does not become definite until we have assigned a definite velocity to a certain point."

Query—What is a "definite velocity"? Is it to be defined in terms of length and time in the usual way, and, if so, how are length and time to be measured? For, as Mr. Cunningham remarks:—

(3) "The next thing we may notice is that the notion of the 'length of a body' becomes indefinite along with the term 'simultaneous.'"

(4) "If now we start from the fundamental law that there is a definite physically-determined velocity, that of light. . . ."

Query—What does Mr. Cunningham mean by a "definite physically-determined velocity" in view of statements (1), (2), and (3)?

Things apparently indefinite:—(1) "Simultaneity"; (2) mode of measuring length; (3) mode of measuring time intervals; (4) meaning of velocity.

Query—What are Mr. Cunningham's fundamental concepts? A. A. Robb.

Cambridge, June 20.

It should be fairly clear that the articles referred to by Mr. Robb were written with the intention of showing the need for a revision of the common ideas about space and time, which discussions on the principle of relativity have shown to be deeply ingrained. Mr. Robb would be the first to admit that such a revision is a necessity. The passages quoted above—(1), (2), (3)— were written to emphasise it.

To Mr. Robb's first query it must be replied that in the conceptual scheme of relations which we have evolved out of the data of perception, velocity is defined in terms of length and time in the usual way; but unfortunately experiment has not enabled us to think out a unique way of "measuring" space and time.

To the second query it need only be said that it is universal to think of light as being propagated in time, that this propagation is determined by physical considerations, and that it is at any rate a possible hypothesis that in the conceptual representation of the phenomena this propagation takes place always at a definite rate.

To the third query the reply is that the fundamental "concepts" in the representation of physical phenomena are space and time.

But the articles did not profess to describe in detail a logical scheme of the universe of motion. Mr. Robb's forthcoming work in which this is attempted is anticipated with much interest. E. C.

Distribution of Rainfall on Sunday, June 14.

I am endeavouring to trace out the distribution of the rainfall on Sunday, June 14, in a similar manner to that in which I investigated a thunderstorm some three years ago. May I ask anyone who is interested, and has not already communicated with me, to send as full details as possible either to me or to the British Rainfall Organisation, 62 Camden Square, N.W., unless they would report in due course to the Meteorological Office or to the Royal Meteorological Society?

Especially should I like information on the following points:—When the rain began; when it fell or did not fall; whether there was hail; if so, when and for how long; whether there was wind, and from what directions. It would add to the value of the facts if the precise point of observation were stated.

Information is desired as to the weather outside the storm area, as well as to the conditions where rain fell.

Any observations, however slight, even if they refer only to one particular time, will be welcome and useful.

J. Fairgrieve.

London Day Training College (University of London), Southampton Row, London, W.C., June 26.

The Photo-electric Effect of Carbon as Influenced by its Absorbed Gases.

The existing contradictory results on the photo-electric effect of carbon can be explained by means of the quantity and quality of the gases absorbed by the carbon. The influences of ammonia, hydrogen, air, and carbon dioxide were investigated. The most consistent results were obtained from carbonised bamboo and hydrogen. Saturation curves showed ammonia to be the most active, and carbon dioxide the least. Distribution of velocity curves were obtained for bamboo and hydrogen. The maximum initial velocity was found to be independent of the quantity of hydrogen absorbed, while the maximum current was proportional to the quantity of gas absorbed.

O. Stuhlmann.
R. Piersol.

University of Pennsylvania, June 17.

MAYA ART.[1]

EXCEPTING the splendid labours of A. P. Maudslay, embodied in four volumes of beautiful illustrations, with a descriptive text, the study of old Maya civilisation is almost entirely German-American, and it became a science through Foerstemann, who, with marvellous intuition, was the first to read some of the glyphs.

It is a study quite self-contained, fascinating, but leading apparently nowhere. When the Spaniards conquered Middle America, the Maya glory was already a thing of the past, whilst the Mexican civilisation was at its height. This also has vanished without in the slightest degree

[1] Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. vi. A Study of Maya Art: Its Subject Matter and Historical Development. By H. J. Spinden. Pp. xxiii+285+29 plates+map. (Cambridge, Mass; Peabody Museum, 1913.)

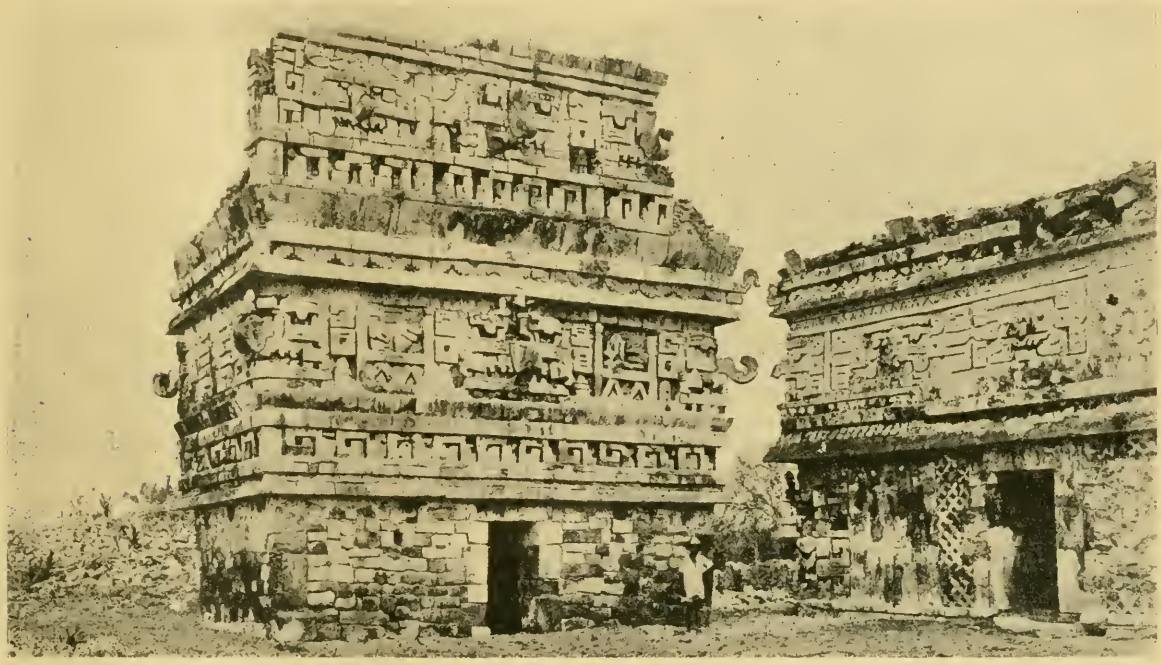
having influenced the present civilisation, which is entirely Spanish, certainly Latin. The natives neither know nor care anything about the monuments of their ancestors, more often than not they do not even consider them as ancestral, but merely as relics of the olden times. Christianity —and they are nearly all nominal Christians— has smothered, or ruthlessly destroyed, the old life and its traditions. Idolatry being forbidden by law, it is practised more or less secretly, and many old heathen rites have been cleverly woven into the orthodox practices of the Church, especially with the celebrations of the numerous feast days.

The ancient eastern civilisations from Egypt to India and China are more or less akin, have influenced each other, and their effect lasts into our own present-day life. Almost any Mesopotamian find is sure to throw some light upon the history of the European-Asiatic communities. Nothing of the kind applies to America. If it had been found uninhabited by the Europeans, that would in the long run have had no effect upon the culture and thoughts of the rest of the world. As it happened that there were natives, they have been used as beasts of labour. They were sweated, but not more than the Aztecs had sweated and raided the other tribes.

Dr. Spinden is a pupil of the active and flourishing School of American Archæology, under the guidance of Dr. Tozzer, at Harvard University. His most noteworthy contribution in the present volume is the exposition of the archæological sequence of the Maya monuments.

Who are the Mayas? Maya-speaking people inhabit the Mexican States of Tabasco, Chiapas, and Yucatan, south of the Isthmus of Tehuantepec, besides Guatemala and Honduras. To the north and west this larger Maya area adjoins those of the Zapotecan (Mitla) and Nahoan or Mexican civilisations.

It seems most probable that the mysterious Toltecs were those Mayas in a wider sense, who, in prehistoric times, had extended on to the plateau of Mexico, raising there the great pyramids of Teotihuacan, Cholula, etc. Then the Nahoa, coming originally from the north and west, drove out the Toltecs, and themselves gradually became civilised, building upon the inheritance, the longer they remained in contact with the Toltec-Maya crafts, arts, and science, which continued to flourish in the far south-east. Even so late as shortly before the Spanish conquest the Aztecs or Mexicans proper were sending military colonies down to Nicaragua. Spinden accepting this view, considers the pre-Aztec monuments on the plateau as contemporary with what he designates as the brilliant period of building in Mayaland; the fine Aztec and Zapotec buildings arose later.



The "Church" at Chichen Itza in Yucatan.

The ethnology is very doubtful; anything before 1325, the generally accepted date of the foundation of the city of Mexico, is fictitious. The Codices, illuminated manuscripts, are picture-writings, a compound of idiograph-pictures, and phonetic writing, just on the verge of the invention of an alphabet. It is a highly developed art of pun-drawings, or rebus. Whilst the Nahoa codices—they were nearly all almanacs, or memoranda of accounts—are easy to read, so far as names of places and numbers are concerned, those of the Maya had far advanced, the pictures having been condensed into much conventionalised signs, and nothing but cyphers and sums have been made out with some certainty. The rest is guesswork, run wild.

The Nahoa, Zapotecs, and Tarascans had risen to kingships, but the Maya were split into many small tribes, independent, and each under its own hereditary chief, a condition of things which makes it difficult to account for the splendour and size of the temples and other public buildings, unless, as Spinden suggests, the old Maya, like the Greeks, were religiously and artistically a nation, but politically a number of small sovereign States. Little is known about their religious ideas. They worshipped many deities—above all, one represented by the plumed serpent, with endless symbolic variations. The ceremonials centred in processions, incense-burning, and human sacrifices, the victims being supplied by raids. The ritual, the appeasement of the many deities in their various phases and imagined manifestations, necessitated a most elaborate calendar, which, together with their complicated chronology, implied a considerable amount of astronomical knowledge.

Foremost in the field of work at Mayan antiquities is the Peabody Museum. "Maya art was on a much higher scale than any art in America, except, possibly, the textile art of Peru." "The ancient masterpieces of Yucatan and Central America show a fine technique and an admirable artistic sense, largely given over to the expression of barbarous religious concepts, and they furnish many analogies to the early products of the classic Mediterranean lands. Indeed, upon such technical grounds as fore-shortening, composition, and design, Maya art was in advance of the art of Assyria and Egypt, and only below that of Greece in the list of great national achievements." But whilst the Greeks apotheosised the human form, the Maya gods and heroes had fundamentally the characteristics of reptiles, birds, and beasts, more or less humanised grotesque figures, often smothered, overpowered by the detail of symbolical attributes.

Painting in colours upon paper and excellent plaster, carving in wood and stone, modelling in clay and stucco, low and high relief, and full round, were much practised, and these people would have accomplished more if they had risen to iron and bronze chisels, instead of implements of stone and obsidian, and if the country had supplied them with marble instead of a coarse and uneven limestone.

Our author has arranged the numerous principal monuments of Copan in Honduras upon a primarily stylistic principle. They fall into four chronologically successive stages, but it is to be remembered that a new type of stela, for instance, was well begun before the old type was abandoned, so that there is a considerable overlap; provided always that their Maya dates have been correctly interpreted, which is by no means always the case.

First: the stelæ show glyphs of archaic form, and in low, flat relief. Altars are drum-shaped, plain, or with rudely carved ornamental symbols.

Second: the stelæ are sculptured, with gradually higher relief. The face of the figure is that of an animal. The head-dress of the figure consists of the face of an animal. The heels stand together, with toes turned outward, forming an angle of 180°.

Third: the stelæ are sculptured. Grotesque faces with turban-dress.

Fourth: stelæ sculptured, practically in full round, with considerable modelling of face and limbs, which assume a less awkward position. Elaborate head-dress with feather-drapery. The altars represent two-headed dragons or serpents, a turtle, or a couple of grotesque jaguars.

The whole development at Copan comprised only 276 years, beginning with the 11th tun of the 4th Katun, and ending with the 10th year of the 18th Katun of the 9th cycle; according to Spinden's assumption from about 250 A.D. to 525 A.D.

For Guatemala and Honduras, where, besides others, the famous monuments of Tikal, Quirigua, and Copan are situated, he distinguishes, after a proto-historic period, an archaic period from 160–755 A.D., upon which follows the great or brilliant period which lasted to about 600 A.D. For no particularly binding reasons this is supposed to include the wonderful monuments of Palenque in Tabasco. After some transitional period a Nahoa period in Mexico is fixed at from the year 1195 onwards.

From this it will be seen that the tendency to assign a sensational age to the Central American monuments has given way to more reasonable views, although our author goes quite far enough back when he puts the beginning of the 9th cycle at 160 A.D., whilst others are satisfied with a date several hundred years later.

It may not be amiss to make a few explanatory remarks about this Maya chronology. They had a ceremonial almanac of 260 days; twenty sections of thirteen days each; twenty day-signs of animals and other natural objects, combined in a certain order with the numerals 1–13, so that every one of these 260 days had an absolutely fixed name, number, and position. They reckoned by scores, whilst the number 13, as Foerstemann discovered, is based upon the fact that eight years of 365 days are exactly five years of the planet Venus, which they worshipped. This curious almanac is, in fact, based upon a combination of terrestrial and Venus years.

They had further a civil year of 360 days, called a *tun*; twenty tuns are a *katun*, and twenty katun a cycle or big period. Now, if every score of years is designated by a name-day of the ceremonial almanac, 260 katuns can be fixed without repetition, *i.e.* 5200 years of 360 days. If this unwieldy number is subdivided by a score of scores, 400, there result thirteen cycles. Foerstemann has further discovered that the zero of the whole reckoning system refers to a day which in this almost perpetual calendar is a 4 Ahau katun, which begins with the eighth day of the score called Kumku. This has therefore been called the normal or zero date, from which all the monumental dates reckon in days, scores of days, years, scores of years, and cycles. Astronomers do not seem to have taken up the question whether this zero-date, which lies somewhere near 3000 B.C., may possibly refer to some remarkable planetary configuration. It may, however, be altogether fictitious. Very little is known about their cosmogony, and it is not known why they should have considered themselves in the ninth cycle of their world's history when they constructed the Quirigua and Copan monuments. This mode of reckoning was still used at the Spanish conquest, but as they had not invented a leap-year correction they occasionally shifted their new year's day to make the religious feasts tally with the actual seasons. But since it is not known when such shifts were made, and since the various nations did not interpolate alike, none of the numerous dates can be determined.

Most of this American archæology is still in the descriptive stage. For instance, the less there is known about the reason why the chief deity, or hero, Kukulcan or Quetzacoatl, the Great Plumed Serpent, is thus represented, the more minutely he is described and figured wherever a fragment of him is found. We can see that it is a snake. But the answer to the pertinent question: Why a serpent? That there is no particular reason except that "the body of a snake combines readily in art with certain characteristic parts of other animals," that it lends itself especially well to design and ornamentation, is rather disappointing.

H. G.

BIRDS AND WEATHER.[1]

THE difficult question of the influence of meteorological conditions on the phenomena of bird migration has fortunately been very thoroughly studied as regards the British area, but we are none the less glad to welcome the recent labours of Dr. Defant on this subject. Dr. Defant as a meteorologist has submitted to a critical examination the data collected some years ago regarding the spring arrival in Austria of some thirty species of birds. He has selected four species for special treatment, and the data cover a period of seven seasons (1897–1903). The published weather reports have supplied all the necessary meteorological data for the corresponding periods.

At the outset of his paper Dr. Defant points out that, while all meteorological factors must be taken into account, the relation of all other conditions to that of atmospheric pressure renders possible a concentrated attention on the latter. A comparison of the ornithological data with the temperature records gave a purely negative result, no direct relation being discoverable. Dr. Defant also rightly insists on the importance of considering the weather of the whole of southern Europe, the conditions prevailing in the actual area of arrival being obviously less important than those in the regions immediately to the south through which the migrants must pass.

The spring immigration of the starling and the lark are treated together, these species showing a detailed similarity in this aspect of their seasonal movements. Tables are given showing that there is an annual variation both in the earliest date of arrival and in the duration of the influx. The period of heavy immigration usually lasts about eight days and the average date of maximum arrival for the seven years was February 23, while the average dates for particular years varied from February 12 to March 3.

With the partial exception of one year out of the seven it was found that the periods of maximum immigration coincided with periods of low atmospheric pressure in the west and north-west of Europe and higher pressure in the south, south-east, or east. These conditions give southerly or south-easterly winds in Austria and the countries immediately to the south, and usually rising temperatures. The immigration was all the greater when these favourable conditions had been immediately preceded by a prevalence of high pressure in the north and north-west (or north-east) and low pressure in the east or south-east; such conditions usually entail low temperatures and northerly or north-westerly winds.

Dr. Defant then considers the average daily pressure for the three regions into which he divides southern Europe. These are A = western Asia Minor, the Balkan Peninsula, the Adriatic Sea, and southern Italy; B = the remaining greater part of Italy, the western Mediterranean and northern Africa; and C = Spain and Portugal. The last-named region is soon shown to be irrelevant, and Dr. Defant's second conclusion results from a comparison between A and B. He finds that strong immigration in Austria occurred when the pressure in these regions was relatively higher than on the days immediately before and after and when the pressure in A was higher than in B. The east to west pressure gradient thus formed when coupled with the effect of the earth's rotation produces the south-easterly winds characteristic of the type of weather already described as favourable to migration.

The cuckoo and the house martin are then treated in like manner (not jointly as in the previous case, but simultaneously to economise space in tables and graphs). The same two conclusions are arrived at for these immigrations occurring much later in the season than that of the starling and the lark. A second type of weather was also found favourable in the case of the cuckoo, namely, extended high pressure over the whole of central and southern Europe, usually with weak easterly or north-easterly winds. In seasons

[1] "Der Einfluss des Wetters auf die Ankunftszeiten der Zugvögel im Frühling." By Dr. A. Defant, Vienna. Reprinted from *Schwalbe*, new series, vol. iii., 1913, pp. 135–56, and charts.

in which the strongest immigration occurred under such conditions the period of the chief movement was protracted to about nineteen (instead of about nine) days.

Dr. Defant has clearly proved that a certain type of weather is peculiarly favourable for the spring immigration of Austrian birds. He is to be congratulated on his clear and well reasoned treatment of very unwieldy data and on having made a valuable contribution to a difficult subject.

His further speculations are, however, open to serious criticism. He believes that the important factor in this type of weather is the wind and that birds prefer to fly with it behind them. His reasons as to *why* birds should do so seem to us to be wholly beside the point, and as the much more comprehensive results already obtained in this country are entirely opposed to Dr. Defant's theory, we cannot accept it, however temptingly obvious it may seem, on such very slender grounds.

The alternative theory is that "the winds and the performance, or non-performance, of the migratory movements are the effects of a common cause—namely, the particular type of weather prevailing at the time, which may be favourable or unfavourable for the flight of birds. . . ." (Eagle Clarke, "Studies in Bird Migration," 1912, p. 173).

In the British area there are certain types of weather favourable respectively for migration between the British Isles and northern Europe, between the British Isles and Iceland, and between the British Isles and south-western Europe. The winds accompanying these types of weather *may or may not* be in the same direction as the movements concerned. Furthermore, the same types of weather favour these movements both in autumn and in spring, the direction of flight being reversed, while the prevailing winds remain the same.

In Dr. Defant's simpler case it so happens that the favourable type of weather he has discovered produces a wind in the same direction as that of immigration from the Balkan Peninsula (his region "A") to Austria; but the immigration from the south-west ("B") probably forms a large part of the movements which were the subject of investigation. It is unfortunate that only the spring migrations have been dealt with. Should the same type of weather with its accompanying winds prove to be favourable to the autumn emigration (as in the case of the British movements), Dr. Defant's theory would be quite untenable.

In the meantime, Dr. Defant's selection of wind as the important factor is purely speculative, and his view entails an entirely different relation between birds and weather in Austria from that existing in the British Isles. While rejecting his theory of the importance of wind as unproven and improbable, we feel grateful for the new facts which he has added to our knowledge of bird migration by his most laborious and thorough research.

A. LANDSBOROUGH THOMSON.

METROLOGICAL RESEARCHES.[1]

THE volumes referred to below contain particulars of recent metrological researches made at the international bureau of weights and measures. As the result of a long series of investigations on the length of invar wires used for geodetical measurements, it has been found that wires made of metal taken from the same tapping or ladle and treated in the same manner have practically the same coefficients of expansion; the differences from the mean lying within $\pm 0{\cdot}03 \times 10^{-6}$. If the same coefficient of expansion were adopted for all such wires it would need a difference of temperature of 30° C. to introduce an error of one part in a million. There is now no difficulty in procuring invar wires having a coefficient of expansion as small as $0{\cdot}1 \times 10^{-6}$.

At the fifth general conference on weights and measures held in Paris in October last, a resolution was passed to the effect that in view of the fact that the force of gravity is not precisely the same at sea-level for all places having the same latitude, it was undesirable that the value adopted for the normal force of gravity (viz., 980·665 cm. sec.$^{-2}$) should continue to be defined as that corresponding to a particular latitude (45°). In the reduction of observations the theoretical factor given by Clairaut's formula in the amended form now usually adopted should no longer be employed, but merely the numerical ratio of the normal force of gravity to that at the place of observation, the latter being determined directly if possible.

The normal scale of temperature hitherto adopted at the international bureau of weights and measures has been that of hydrogen at constant volume. The fifth general conference resolved that the absolute thermodynamic scale shall be substituted for the hydrogen scale as soon as the table of reduction from one scale to the other has been determined with sufficient certainty. It was also recommended that a number of thermometric fixed points be ascertained with as great accuracy as possible, in order to facilitate the calibration of thermometers. A meeting of the principals of the various national laboratories is to be arranged at Sèvres for the purpose of deciding what these fixed points shall be and how they are to be determined, as well as to promote their general recognition.

The question of the determination of the length of the metre in terms of wave-lengths of light was considered at the fourth general conference. It was decided that investigation on this subject had not then reached the stage for the conference to adopt any particular number of wave-lengths as representing the metre. Further researches made by physicists will be carefully studied at the international bureau with the view of obtaining in the course of time a fundamental

[1] Comité internationale des poids et mesures. Procès-verbaux des séances. Deuxième série, tome vii., session de 1913. Pp. v+140. (Paris: Gauthier-Villars, 1913.)
Travaux et Mémoires du bureau international des poids et mesures. Tome xv. (Paris: Gauthier-Villars, 1913.)

relation between the metre and a suitable wave-length of light.

All who have been brought into contact with Dr. René Benoît, for so many years director of the international bureau, will regret to hear that he will be retiring from that position at the end of the present year. Dr. Benoît has been identified with all the principal researches which have been undertaken at that institution during the last thirty-six years. In this country his services in connection with establishing the relations between the units of the British and the metric systems of weight and measure will be especially remembered.

A GREAT TELESCOPE FOR CANADA.

A NOTABLE addition is to be made to the equipment of the Dominion Astronomical Observatory at Ottawa, Canada. At present its chief instrument is a 15-in. refractor. This has been used mainly for radial velocity determinations, and for some time its limitations have been keenly felt. Using low dispersion, spectrograms of fifth magnitude stars could be obtained, but beyond this it was ineffective, and it was recognised that further progress demanded a more powerful instrument. Supported by various scientific societies and representative astronomers, the chief astronomer, Dr. W. F. King, appealed to the Dominion Government for improved equipment, and the request was successful.

Contracts have been made for the construction of a 72-in. reflector. The optical parts will be made by the John A. Brashear Co., of Pittsburgh, Pa., and the mounting by Warner and Swasey, of Cleveland, Ohio. The cost will be about 90,000 dollars (18,000*l.*).

The focal length of the great mirror will be 30 ft., with a hole ten inches in diameter at its centre to allow for a Cassegrain combination. For this purpose a convex hyperboloidal mirror, with an aperture of 19 in. and a focal length of 10 ft., will be placed 23 ft. above the main mirror. The resulting focal length will be 108 ft.

The mounting will resemble those of the Melbourne and Ann Arbor reflectors. The skeleton tube will be at one side of the long polar axis, nearly midway between its bearings, the balance being restored by the declination mechanism and counterweights on the other side of the axis. It is hoped to have the telescope completed within two years.

The instrument will be used primarily for spectrographic determination of radial velocities. For the brighter stars it will be used in the Cassegrain form just described, the spectrograph being attached in the axis of the tube, below the 10-in. opening in the mirror. For the fainter stars a low-dispersion spectrograph will be attached at the principal focus. Direct photography of nebulæ, clusters, and other small areas of the sky will also be attempted.

To be used effectively, such an instrument demands a suitable position, and for more than a year Mr. W. E. Harper, of the observatory staff, has been investigating the astronomical possibilities of various regions ranging from Ottawa to the Pacific coast. Of all those tested, Victoria, B.C., showed a decided superiority in good "seeing" and small nocturnal range of temperature, and accordingly that place was chosen. The precise site is on Saanich Hill (elevation 732 ft.), about seven miles north of the city, from which it is easily reached by electric railway and carriage road.

The great dome will be 66 ft. in diameter and 60 ft. high. A building to contain offices, library, and reading rooms will also be erected. The total cost of buildings and equipment will be about 200,000 dollars (40,000*l.*). All the plans and specifications have been made by Dr. J. S. Plaskett, after consultation with many experts, and he will be in charge of the station.

C. A. CHANT.

NOTES.

DR. F. W. DYSON, Astronomer Royal, has been elected a correspondant of the Paris Academy of Sciences, in the section of astronomy.

VICE-ADMIRAL SIR EDMOND J. W. SLADE, K.C.I.E., K.C.V.O., has consented to act as president of the Meteorological Conference to be held in Edinburgh next September.

THE Bill introduced in the House of Commons by Sir Frederick Banbury, to prohibit experiments on dogs, was withdrawn on Tuesday, June 30, after a number of amendments to the principal clause had been carried in the Standing Committee appointed to consider the Bill.

MR. W. O. REDMAN KING, lecturer in zoology at the University of Leeds, has been appointed Ray Lankester investigator at the Marine Biological Laboratory at Plymouth, in succession to Prof. E. L. Bouvier, of Paris. The investigator is required to undertake research work of his own choosing at the laboratory for a period of five months, the emolument being 70*l.*

SIR JAMES CAIRD, of Dundee, has given 24,000*l.*, free of any conditions, to Sir Ernest Shackleton's Imperial Trans-Antarctic expedition. This gift relieves Sir Ernest of anxiety as to the financial side of the expedition, which will now be able to start well equipped in about a month's time. Further subscriptions would, however, be not unwelcome, and would be used to obtain accessories for increased efficiency.

THE Geologists' Association has arranged a long excursion to the Rhenish Westphalian Upland, including the volcanic districts of the Eifel, Siebengebirge, etc., on September 4–19 next. The various daily excursions will be attended by Prof. G. Steinmann, Dr. Tilman, and others as directors. The official party will leave Charing Cross on September 4, at 9 p.m. The excursion secretary is Mr. E. Montag, 18 Woodchurch Road, Prenton, Birkenhead.

AT the annual meeting of the Royal Society of Arts, held on Wednesday, June 24, the Duke of Connaught was re-elected president. A new by-law was adopted authorising members of the society to call themselves fellows. Since its foundation in 1754 the society has consisted of members only, but as most of the younger societies use the term fellow, many members of the society have expressed a wish that this title should also be used by members of the Royal Society of Arts.

THE Institute of Archæology in connection with the University of Liverpool, has arranged, in the rooms of the Society of Antiquaries, Burlington House, Piccadilly, on July 7–25, a special exhibition of antiquities, discovered at the excavations at Meroë, Sudan, during the past five seasons. The council of the University of Liverpool, we notice, has approved the acceptance by Prof. John Garstang, director of the excavations, of an invitation from the Sudan Government to be their honorary adviser to the Service of Antiquities of the Sudan.

THE statue of Captain Cook, the explorer, executed by Sir Thomas Brock, R.A., is to be unveiled on July 7 at noon. The statue has been placed on the Mall side of the Admiralty Arch, at the end of the Processional Road. It will be remembered that a statue of Captain Cook presented to the town of Whitby by the Hon. Gervase Beckett, M.P., was unveiled in that town on October 2, 1912. The erection of a fitting memorial to the great explorer in the capital of the Empire is largely due to the activity of the British Empire League.

IN a paper read before the Royal Geographical Society on June 22, Captain F. M. Bailey described his exploration of the Tsangpo, or Upper Brahmaputra river. The main results of the expedition were as follows:—The mapping of some 380 miles of the Tsangpo, which had previously been done by untrained or untrustworthy explorers; the mapping of the lower course of the Nagong Chu; the discovery of Gyala Peri, a snow-peak 24,460 ft. in height, and its glaciers. By observing the river where it breaks through the Himalayas some information regarding its enormous drop has been gained, and the falls reported to be 150 ft. in height have been proved to be merely an exaggerated rapid of 30 ft. The upper waters of the Subansivi have been discovered, and it is proved that this river rises north of the Himalayas, and breaks through the range. Many new snow-peaks, ranges, and rivers have been discovered, and a small collection of mammals, birds, and butterflies, among each of which were new species, was made.

INFORMATION has reached the Royal Geographical Society of the further work accomplished by Sir Aurel Stein in his new Central Asian expedition since he wrote at the end of last year. His objective was the region round Lop-nor, at the other extremity of the Tarim Basin, and various considerations obliged him to travel *viâ* Khotan. Pursuing a route hitherto largely unsurveyed, he moved to Maralbashi along the southernmost range of the Tien-shan, where he found some ruined Buddhist shrines, and thence towards the desert hills of the Mazar-tagh, the most forbidding ground he had hitherto encountered in the Taklamakan. Crossing the Tarim, he reached Niya, where he discovered an important sand-buried settlement with numerous documents inscribed on wood in the Indian language and script, furniture, household implements, etc. Meanwhile his Indian surveyor had resumed the triangulation along the Kun-lun range, thus connecting his observations with the Indian Trigonometrical Survey beyond the actual Lop-nor. Ample evidence of Chinese occupation, in the shape of a well-built fort and relics of the silk trade, which we know to have been a chief factor in opening the earliest route for Chinese direct intercourse with Central Asia and the distant West, was discovered. The ancient caravan route was marked by hundreds of early Chinese copper coins and unused arrow-heads dropped during the night marches. The difficulties were over when some scanty vegetation was reached, and the various parties reunited at Kumkuduk. A short halt at Tunhuang towards the end of March refreshed men and beasts, and after a renewed visit to the "Halls of the Thousand Buddhas," Sir Aurel Stein at the time of writing was starting to move into Kan-su for the work of the spring.

MANY readers of this journal will learn with deep regret of the death on June 13 of Mr. Thomas Thorp, whose name is widely known in connection with his transparent celluloid replicas of Rowland's and other diffraction gratings, whereby spectroscopes of high dispersion may be produced at a trifling cost. Born at Whitefield, near Manchester, and educated at the Manchester Grammar School, Mr. Thorp was apprenticed to a firm of architects and surveyors. Soon, however, he evinced a strong mechanical and scientific bent, and, happily combining a wonderful scientific ingenuity with a keen appreciation of the practical application of his inventions, he was able to follow his inclinations, to the great benefit of science and of industry. A much larger world owes to him the first "penny-in-the-slot" gas-meter. While every mechanical device was an object of fascination, optical instruments were most constantly in his thoughts. A keen amateur astronomer, he made himself several telescopes and took up the manufacture of small mirrors. His replica gratings were invented many years ago, but he constantly returned to the subject, producing silvered replicas, applying them to direct-vision spectroscopes, and especially applying the transparent replicas to colour-photography, for which last invention he was awarded the premium under the Wilde Endowment Fund by the Manchester Literary and Philosophical Society. Almost his latest invention was an ingenious method of varnishing telescope mirrors to prevent tarnish—a feat which he accomplished without sensibly impairing the definition. At the time of his death he was engaged on a machine by which he hoped to rule gratings superior to any yet produced. Mr. Thorp became a member of the Manchester Literary and Philosophical Society in 1896, and was one of the most valued members of its council from 1902 until his death. The Manchester Astronomical Society was similarly indebted to him. A man of sterling quality, beloved by all who knew him, some regret must be felt that an aversion to publication hindered the spread of his richly deserved reputation.

A VERY interesting exhibition of African big-game trophies, organised by *Country Life*, was opened on June 25 at the Royal Water Colour Society's Gallery, 5*a*, Pall Mall East, and will remain open until July 11. The total number of exhibits is 312, the greater portion of which are antelopes, the remainder comprising a couple of East African giraffe heads, some elephant tusks, a few rhinoceros heads, and heads of wart-hog, ibex, wild sheep, etc. The specimens are arranged, in the main, in zoological order, and are grouped, as a rule, in species, without recognition of races, and without scientific names, the same plan being followed in the catalogue. It is, however, difficult to understand why Diggle's hartebeest, which is but a local race of the tora, is widely separated from the typical race of that species, while the Sudani race of the bohor reedbuck, which is so remarkably different from the typical form of that species, is not distinguished from the latter. A similar remark is applicable to the separation of Buffon's kob from the white-eared kob, both these being merely races of a single variable species; it also applies, in a less degree to the sundering of the red lechwe from Mrs. Gray's black lechwe. As regards the trophies themselves, they include some of the finest representatives of their respective kinds, the gems of the whole series being perhaps three magnificent sable antelope skulls, each with horns of more than 60 in., and in one case reaching $62\frac{1}{2}$ in. in length. Especially fine, too, are three heads of the giant eland of the Bahr-el-Ghazal, and a bongo head, in spite of its somewhat battered condition, is of special interest on account of its unusually dark colour, which is doubtless an indication of age. A western hartebeest head is noticeable for the great development of a light spectacle-mark, recalling that of Hunter's hartebeest. A number of other interesting specimens well deserve mention, but limitations of space prevent more than directing attention to the magnificent series of East African buffalo-heads. The exhibition reflects great credit on its organisers, although it might have contained a few more "records."

ON Friday last a demonstration of Williams's Fire-damp Indicator was given at the Hotel Cecil. Instruments for detecting firedamp have been based on two broadly different principles. Some have depended upon the physical properties of the gas, in particular on its density, but these have suffered from want of sensitiveness and also from actual error unless the carbonic anhydride present is absorbed. An instrument of this class, in which the musical notes emitted by two pipes, one containing normal air and the other the air of the mine to be tested, but with the heavy and disturbing CO_2 removed, which gave rise to beats in the presence of a notable quantity of firedamp, has recently attracted some attention in Germany. The other class depends upon the heat of combustion of the gas present when helped by extraneous heating. This system is the more satisfactory, as there is so much more available and possible effect. A highly satisfactory instrument of this class was made about 1877, invented by E. H. Liveing, the well-known mining engineer; but though it would certainly show the presence of $\frac{1}{4}$ per cent. firedamp, while $\frac{1}{2}$ per cent. was highly conspicuous, and it required nothing more than the turning of a handle to operate it, colliery engineers and proprietors at the time did not in general care to have it about the mine. The instrument invented by Mr. Williams belongs to this general class, but Prof. S. P. Thompson's report does not indicate that progress has been made in the direction either of simplicity or of delicacy. Shortly, it depends on the excess of temperature set up in one of two little balls of porous material containing platinum black, which are heated by an electrical current, and one of which is exposed to the air of the colliery. This one becomes the hotter of the two, and the excess of temperature is determined by electrical means. If, when the instrument is manufactured, it is found to work in an easy and satisfactory manner, it is to be hoped that the thirty-seven years which have elapsed since the construction of the Liveing instrument will have brought about some change in the attitude of those whom it is hoped to benefit.

THE question of the admissibility of evidence in criminal cases to prove the facts of detection of crime by bloodhounds has been at last raised in the Courts of Law. In a case before the High Court, Allahabad, reported in the *Pioneer Mail* of May 22, evidence was called to show that a cap and turban were found in the room of a murdered woman, and on these being shown to the dog, he guided the police to the house of the accused. The counsel for the defence objected to the admission of this evidence, on the ground of the impossibility of cross-examining the animal. This question was not actually decided; but the judge remarked: "I feel no hesitation in saying that the employment of trained intelligence of an animal of this description as an aid to detective work should, so far as possible, be confined to the detection of crime or the tracing down of an individual whose whereabouts are unknown, rather than for probative purposes. If the court is asked at the trial to draw inferences of vital importance from the conduct of an animal, it then becomes necessary that the court should have before it expert evidence of the very best description in order that it may feel justified in drawing them with certainty."

IN a paper recently read before the Royal Anthropological Institute, Profs. Seligmann and Parsons discussed a skeleton from one of the Cheddar caves discovered by the late Mr. R. C. Gough in 1877, and associated with bones of extinct animals, including bear, hyæna, bison, rhinoceros, and Irish elk. Stone implements found close to the skeleton are recognised by M. Breuil as belonging to the Magdalenian culture, the latest stage of the Palæolithic period. The prognathism of the skull is slight, and the Cheddar man did not possess the beetling brows of the Mousterian period. He seems to belong to the River-bed race, but this race is at present indistinguishable to the anatomist from the Neolithic people who, at a later period, buried their dead in the long barrows.

THE committee of the Castle Museum, Norwich, in their report for 1913, records a most successful year, the attendance and gate-money being remarkably good, and the list of additions large. Among the latter are a number of specimens of Indian and African big game, inclusive of a proportion on loan. Nature-study exhibitions formed a feature of the year's work.

IN the report of the council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, for 1904–10, published in vol. iv., part 1, of the new series of Transactions, attention is directed to the serious falling off in the number of members, which at that date was only 395. Had it not been for the Crawhall bequest of 6000*l*., the position of the society would have been serious, and the maintenance, to say nothing of the improvement, of the museum jeopardised.

VARIOUS kinds of interesting "animals" and birds in the Zoological Gardens form the subject of an illustrated article in the July number of the *Children's Magazine*, issued by the publishers of the "Children's Encyclopædia." Most striking of all is a photograph of the long-beaked echidna of New Guinea, despite the circumstance that the creature is referred to merely as the "egg-laying echidna," without regard to the fact that it represents a genus apart from the ordinary echidna, and also that it is alluded to "as a link with the ancient reptiles before the mammals came."

ACCORDING to the Annual Report on Sea-Fisheries, issued, in two parts, on June 19, the value of the catch landed in England and Wales during 1913 was no less than 10,337,000*l*., an increase of considerably more than a million over that of the previous year, which was the highest on record. Exclusive of "shell-fish," the weight of the food thus gathered amounted to something like 16,000,000 cwt., a very considerable proportion of the increase over 1912 being due to the prodigious take of herrings. A portion of this immense food-supply was diverted from the British Isles to go to foreign—mainly Dutch—ports, where a brisk and increasing trade in this commodity has sprung up of late years.

ALBEIT reported to be somewhat unwholesome, hilsa (*Clupea ilisha*) is by far the most succulent and tasty native fish served, during the rainy season, at Calcutta tables. With a view of increasing the supply, attempts at artificial propagation of the species were made in Bihar in the autumn of 1911 and 1912, when the fish are ascending the big rivers. These, however, according to a report by Mr. T. Southwell in a recent issue of the *Bihar Agricultural Journal*, proved unsuccessful, partly owing to the lack of ripe fish, and partly to the fact that the natural breeding places have not yet been discovered. Other attempts, on the lines of the shad-hatcheries in the United States, are to be attempted.

MR. J. H. ORTON, one of the naturalists of the Marine Biological Association's Laboratory at Plymouth, has for some time past been engaged in a comparative study of the ciliary mechanisms of various invertebrates and protochordates, and his latest contribution to the subject appears in a recent number of the Journal of the association (vol. x., No. 2). Mr. Orton shows that the "gill" in such widely separated animals as Crepidula, Lamellibranchiate Mollusca, Ascidians, and Amphioxus, is in the main an organ for collecting food and passing it to the alimentary canal. His views with regard to the mechanism of the process differ somewhat from those of certain earlier observers. Apparently the endostyle serves merely to secrete mucus and sweep it into the gill filaments, not as a food channel. One of his most interesting results is the discovery of an "endostyle" in the gasteropod Crepidula, which histologically closely resembles that of Amphioxus, and thus constitutes an extremely interesting case of convergent evolution.

IN NATURE of June 4 (p. 350), Lieut.-Col. Manners-Smith challenged some statements as to the destruction of bird-life in Nipal, made by Sir H. H. Johnston in an article on "The Plumage Bill," contributed to our issue of December 11, 1913. Sir Harry Johnston based his remarks partly upon reports by Mr. C. William Beebe, curator of birds, New York Zoological Society; and he has now sent us a letter from Mr. Beebe, from which we print the following extract:—"In that part of my pheasant monograph which deals with the pheasants and tragopans of Nipal, I have spoken of the havoc which the Nipalese shepherds are working, at least in the eastern part of the country. This I know from my own observations. There seems practically no way to put an end to the trapping of these men which goes on throughout the year. When I was in Calcutta, I was shown large boxes and bales of pheasant and other skins being exported for sale to milliners. The British officials told me that they were powerless to interfere, as the freight was sealed by the Rajah of Nipal's Government, and they, of course, had no authority to stop the exportation of goods from an independent country."

THE Hawaiian Volcano Observatory, which was built in 1812 on the edge of the crater of Kilauea, near the well-known Volcano House, is doing most useful work under the direction of Dr. T. A. Jaggar. Every week a bulletin appears giving an account of all changes taking place within the crater, and the varying activities of the several vents within it. The observatory was built, and is supported by, subscribers belonging to the Massachusetts Institute of Technology, and by other voluntary helpers in the Hawaiian Islands. The Whitney Laboratory of Seismology, which is established in the basement of the observatory, is furnished with the improved Omori seismometers and tromometers, their records being published in the same weekly bulletin. Scientific men desirous of carrying on vulcanological investigations are welcomed by the board of directors, and recently the facilities afforded at the observatory have permitted of very valuable observations being made on the gases emitted from the vents. The bulletin, of which, in its collected form, a second volume is being published, can be supplied to annual subscribers and to workers in vulcanology and seismology, as well as to scientific libraries in exchange for other publications.

IT may be interesting to note that while, generally speaking, the second half of April last was "very dry" in this country, very heavy rains accompanied by much flooding occurred generally over the Argentine Republic. An article by Mr. R. C. Mossman in *Symons's Meteorological Magazine* for June states that between April 21 and 27 from 8 to 14 in. of rain fell during a cyclone in the northern parts of that country, the maximum daily falls being from $8\frac{1}{2}$ to 9 in. Mr. Mossman states that although similar intensity has occurred locally in previous floods, it is not thought that such a widespread rainstorm has occurred before. Owing to difficulties of road transit it has been impossible in many instances to get the maize crop to the railway stations, with the result that an enormous deficit is already apparent in the receipts of the various railway companies.

In the Journal of the Washington Academy of Sciences for June 4, Mr. F. E. Wright, of the Geophysical Laboratory, gives a *résumé* of the methods hitherto available for the determination of the index of refraction of a small drop of a liquid, and describes some interesting improvements he has introduced. One of these enables the index to be determined with an ordinary petrographic microscope to one unit in the third decimal place. It depends on the use of a stage refractometer made from a small sheet of optically dense lead glass, the upper surface polished, the lower parallel surface matt, and the edge bevelled to make an angle of 60° with the former surfaces. The sheet is cut in two by a plane perpendicular to the bevelled edge, one-half turned over, and the two bevelled edges brought together. Between them the drop is placed, and the boundary between the transmitted and totally reflected portions of the field, is read on the eyepiece scale, which is calibrated by the help of standard liquids. A simple device which enables the Abbe-Pulfrich refractometer to be used with light incident at the grazing angle, even with a small drop of liquid, is also described.

In the *Atti dei Lincei* (vol. xxiii., p. 523) Prof. L. Marino and F. Gonnelli describe a modification of the ordinary Kjeldahl method for estimating nitrogen based on the pronounced catalytic activity of vanadium oxide. It is shown that, by carrying out the ordinary decomposition process with sulphuric acid in presence of potassium sulphate and a trace of vanadium pentoxide exact results are obtained in a large number of cases. The process suggested is recommended when the ordinary Gunning process is carried out with difficulty, or in cases where the use of mercury gives rise to mercury-ammoniacal compounds which resist decomposition. It is shown by special experiments that vanadium, even when present in quantity, does not retain even traces of ammonia.

The *South African Journal of Science* (March, 1914) contains a paper by Dr. C. F. Juritz on the chemical composition of rain in the Union of South Africa. This forms part of a scheme for the world-wide and systematic examination of rain-water from the point of view of both composition and total rainfall, and more particularly as regards the nitrogen brought into the soil in the form of rain. The data are as yet somewhat incomplete, but it appears that in general more nitric nitrogen is brought down by the summer than by the winter rains, and the same is true of the nitrogen in the form of ammonia, although the rule is sometimes reversed. The total nitrogen per acre in the rainfall of South Africa ranged from 1·5 to 6·2 lb. per annum. The chlorine was abnormally high in some instances, amounting in the Durban districts to 60–70 lb. per acre.

In the current number of the *Comptes rendus* of the Paris Academy of Sciences is a paper by Otto Scheuer on the reduction of carbon monoxide by hydrogen in the presence of radium emanation. Starting with 240·122 c.c. of a mixture of these two gases containing 43·71 per cent. of hydrogen, after nineteen days the volume was reduced to 217·332 c.c., representing a loss of 1·8 c.c. per Curie-hour. The analysis of the residual gas gave figures consistent with the assumption of the formation of methane, with possibly a little ethane. The gaseous mixture contained neither methyl alcohol nor formaldehyde, but from the appearance of a minute solid deposit in a second experiment the author concludes that formaldehyde may be the primary reduction product, this being finally reduced to methane. The reaction is accompanied by the formation of water.

Engineering for June 26 contains an illustrated article dealing with Mr. F. Baines's report on the condition of the roof timbers of Westminster Hall. Mr. Baines demonstrates the necessity of large and effective repair, and discusses the proper treatment that will give to the roof the necessary strength and support without injuring its historical character or archæological features. Tender regard for the ancient work overthrows all proposals for securing the roof by piecing up defective members, and a system of steel reinforcement has been approved as the most suitable course. Supposing the timber decay to continue, the loads would be borne by the steel reinforcement, and the possibility of complete collapse would be eliminated. An entire truss of steel will be added to the existing timber work, of sufficient strength to support the whole of the present roof, together with the weight of the steel-work itself, so as to bring the total weight of the strengthened roof to a safe and satisfactory bearing on the walls. Both walls and foundations are strong enough to bear the additional weight of the steel and to resist any possible outward thrust such a weighty reinforcement might produce. The work will take six years to execute.

A second edition of Dr. A. Harden's monograph on "Alcoholic Fermentation" has been published by Messrs. Longmans, Green and Co. The first edition was reviewed in the issue of Nature for June 29, 1911 (vol. lxxxvi., p. 579); and though no change has been made in the scope of the work, the rapid progress of the subject has rendered necessary many additions to text, and an increase in the bibliography. —The Society for Promoting Christian Knowledge has published a second edition of Canon McClure's "Modern Substitutes for Traditional Christianity." The first edition was reviewed in Nature on March 26, 1914 (vol. xliii., p. 81), and it will be sufficient to say of the present edition that it has been revised and has added to it a chapter on modernism, which is also issued separately, price 6*d*. net.

A SECOND edition of their List No. 52 has been issued by Messrs. A. Gallenkamp and Co., Ltd., of Sun Street, Finsbury Square, London, E.C. The catalogue deals in an exhaustive manner with charts, diagrams, lanterns, and lantern slides, botanical and hygenic models, and other requirements of lecturers and teachers. The list brings together in a convenient manner the publications, and so on, of a great variety of firms, and will save intending purchasers much time and trouble. Even a glance through these well-illustrated 200 pages is enough to show the wealth of pictorial illustration now at the disposal of lecturers.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY:—

July 2. 11h. om. Earth at greatest distance from the Sun.
8. 23h 27m. Uranus in conjunction with the Moon (Uranus 1° 42′ N.).
9. 19h. 14. Jupiter in conjunction with the Moon (Jupiter 0° 32′ N.).
16. 6h. om. Mercury in inferior conjunction with the Sun.
20. 2h. 43m. Saturn in conjunction with the Moon (Saturn 5° 59′ S.).
21. 2h. om. Neptune in conjunction with the Sun.
,, 19h. 46m. Mercury in conjunction with the Moon (Mercury 8° 37′ S.).
22. 10h. 50m. Neptune in conjunction with the Moon (Neptune 3° 43′ S.).
25. 18h. 24m. Venus in conjunction with the Moon (Venus 1° 52′ N.).
26. 4h. 33m. Mars in conjunction with the Moon (Mars 2° 7′ N.).
,, 17h. om. Mercury stationary.

THE RADIATION OF THE SUN.—The Journal of the Franklin Institute for June (vol. clxxvii., No. 6, p. 641) publishes an article on the "Radiation of the Sun," being an address presented by Prof. C. G. Abbot at the meeting of the section of physics and chemistry. The article is popularly written, and displays the general nature of the problem of solar radiation, and the different researches which have and are being pursued to elucidate the knotty points. Interesting photographs, diagrams, and curves accompany the text, and the name of the distinguished author is a guarantee of the accuracy of the information given. Articles such as the above are most valuable to those whose work in astronomy lies along other lines, but who keenly desire to be posted on the progress of the researches of workers in other branches of the subject.

DISPLACEMENT OF THE LINES TOWARDS THE VIOLET IN THE SOLAR SPECTRUM.—Dr. T. Royds, acting director of the Kodaikanal Observatory, gives the results of his researches (Bulletin No. 38) in the form of a preliminary note on the displacement to the violet of some lines in the solar spectrum. While the majority of the metallic lines in the solar spectrum are shifted towards the red when compared with their positions in the electric arc, there are, however, many exceptions, and some of these are specially dealt with in this paper, the iron arc spectrum being compared with that of the sun's centre. A full list of the wave-lengths of the lines employed and their intensities in long or short arcs, with other data, accompany the discussion. Summarising briefly the results, it may be stated that the iron lines which are unsymmetrically widened to the red in the arc are displaced to the violet in the sun relative to a short iron arc, and those unsymmetrically widened to the violet are displaced to the red. Symmetrical lines give normal displacement to the red. The change of wave-length of certain classes of iron lines is caused in a way other than by pressure or motion in the line of sight. The unsymmetrical iron lines are displaced in the short arc compared with the long arc. Those widened towards the red are displaced to the red in the short arc, and those widened towards the violet to the violet, whilst symmetrical lines have mostly small displacements. Differences in the density of vapour is suggested as a possible cause of the displacement between the different kinds of arc; but the matter, as Dr. Royds remarks, requires further investigation. The longer the iron arc, the more nearly do the conditions approach those in the reversing layer of the sun. Lines of other elements than iron also have sun minus arc displacements, which cannot be explained as due to pressure or line of sight motion.

METEORS ON JUNE 25–26.—Mr. W. F. Denning writes us that, though meteoric phenomena are seldom displayed abundantly on a June night, he observed some strikingly brilliant and interesting meteors on Thursday, June 25. At 10.39 a 2nd magnitude was seen nearly stationary, and close to its radiant at $269°+46°$. At 10.52 a fine meteor, exceeding 1st magnitude, crossed τ Herculis and θ Draconis in a rapid flight, and left a transient streak. Radiant at $260°-24°$, and height of object forty-eight to forty-four miles; path, fourteen miles, and velocity twenty miles a second. At 11.28 a bright meteor equal to Venus fell about 6° to the right of α Andromedæ, and left a streak. Its radiant was at $342°+39°$, and its height fifty-one to twenty-five miles, path forty-five miles, and velocity thirty miles a second. At 11.52 a meteor equal to Jupiter glided down the eastern sky about 2° to the left of α–β Pegasi, its flight being as nearly as possible parallel with those stars. Graceful, slow motion, there was no trace or streak, yellow nucleus. Radiant at $354°+77°$, and height fifty-nine to twenty-three miles. Path, forty-six miles; velocity, eighteen miles a second. At 11.58 another meteor equal to Jupiter shot swiftly upwards in the eastern region of Cygnus, leaving a bright phosphorescent streak for several seconds. Its radiant was on the eastern horizon at $350°-8°$, and its height sixty-seven miles; path, fifty-two miles, and velocity, about fifty-two miles a second. At 12.57 a 3rd magnitude meteor with a streak was directed from a radiant at $24°+42°$, and at 12.58 a very slow 2nd magnitude was seen in Camelopardalus moving from the direction of Ursa Major. Others were observed, and the sky remained beautifully clear during the night. The heights, etc., of the several meteors given are computed from duplicate records obtained by those enthusiastic observers, Mr. and Mrs. Wilson, of Bexley Heath, Kent.

REPORT OF THE U.S. NAVAL OBSERVATORY FOR 1913.—The report of the superintendent of the U.S. Naval Observatory for the fiscal year 1913 forms Appendix 2 to the annual report of the chief of the Bureau of Navigation, 1913. Commencing with the interesting statement that "this observatory, being the first institution in the world to have its time signals regularly transmitted by radio-telegraphy," the superintendent proceeds to describe the part played by the delegates appointed to represent the United States at the International Time Conference which was held in Paris in October, 1913. Reference is next made to the arrangements for the determination of the difference of longitude between the observatories of Paris and Washington using the Eiffel Tower and Arlington as the radio stations for the transmission of the signals. A suggestion is made that owing to the great range of the signals to be sent out from Arlington, advantage will be taken of these signals by other institutions to determine their own longitude. The replies to the issue of a circular letter giving information concerning the special signals have indicated that a number of institutions widely scattered in the United States will utilise the opportunity offered. The report then describes the work carried out during the past year in the different instrumental divisions. These relate to the 9-in. transit circle, 5-in. altazimuth instrument, 6-in. transit circle, 26-in. and 12-in. equatorials, photoheliograph, etc. The reduction work is next summarised, followed finally by that of the department of compasses, chronometers, and other nautical and surveying instruments.

TRADE AND TECHNICAL EDUCATION IN FRANCE AND GERMANY.[1]

THE interesting and important report recently presented to the Education Committee of the London County Council by one of its officers, specially deputed to make the inquiry, on recent developments in the provision of continued and specialised education in France and Germany, deserves the closest attention of all who are seriously concerned with the educational well-being of the children of the United Kingdom, and with the conditions necessary to the maintenance in the highest state of efficiency of our industries and commerce.

The report confines itself to the educational activities of four great cities, namely, Paris, Munich, Leipzig, and Berlin, dealing especially with measures having for their object the continued education of the child on leaving the elementary school, the thorough technical training of the apprentice, and the adequate preparation of the capable young workman or business man for positions of responsibility and leadership.

The question of the higher scientific and technical training is only incidentally treated, its ample provision, especially in the case of Germany, being fully recognised.

The report is, therefore, devoted in the main to the facilities offered in specialised and monotechnic schools, whether day or evening, dealing with specific trades and industries, of which the city of Paris affords abundant illustration in its apprenticeship schools and in its schools of applied design, the work of which was a most interesting feature of the educational section of the Paris Centennial Exhibition of 1900.

But the chief interest of the report is to be found in its description of the provision made, in the three important German cities named, for the continued effective education of German youth on leaving the elementary school and entering upon their respective occupations, "blind alley" or otherwise.

Much stress is laid upon the successful working of the Imperial Law of Industry, establishing compulsory continuation schools, applying especially to all boys on leaving school at fourteen years of age and requiring attendance from six to nine hours a week over a session of forty weeks during a period of three or four years—time for which must be provided by the employer within the usual hours of labour.

[1] Trade and Technical Education in France and Germany. Report by J. C. Smail, Organiser of Trade Schools for Boys, London County Council. (Westminster: P. S. King and Son.) Price 1s.

The result has been, notably in Berlin, Munich, and Leipzig, that provision has been made for almost every class of occupation, skilled and unskilled—the instruction dealing not only with vocational needs, but also preparing the boy for his future responsible domestic and public duties.

Evidence is forthcoming that after a period of doubt and difficulty employers are beginning to appreciate the value and advantage of this continued education and training, though it is somewhat disconcerting to learn that in 1912 in Berlin there were proceedings pending, either on account of school neglect or of offences against school laws under this Act numbering 6,448.

In England, not to speak of the girl population, only 13 per cent. of the boys between fourteen and seventeen years of age are continuing their education, and even this small percentage attends the continuation classes on the average only fifty-eight hours per annum, whilst in Munich virtually all boys engaged in occupation are in the continuation classes and receive 375 hours' instruction per annum for a period of four years. Much praise is given to the admirable facilities existing, especially in the cities of Munich and Leipzig, for the effective training of the commercial and industrial rank and file.

The leaders of German thought and business enterprise are persuaded that in the best interests of the nation all ranks of the industrial army must be thoroughly trained, not only vocationally, but as citizens. They do not fear that they will be less able to compete with their industrial rivals, but, on the contrary; and unless we are prepared to better their example we cannot hope to maintain the industrial and commercial pre-eminence we now enjoy.

We have still to abolish half-time for young children now at school, and to adapt our factory and workshop organisation to conditions which shall secure the educational well-being of the children employed therein.

J. H. REYNOLDS.

MARINE BIOLOGY IN THE TROPICS.[1]

THE Department of Marine Biology of the Carnegie Institution of Washington has issued in this fifth volume of contributions from its laboratory on the Tortugas, near Florida, a number of important papers. Three of these deal with the origin of Oolitic rocks, such as those of the Bahamas and of Florida, and inferentially with the origin of oolitic structure in other deposits. The first paper is the last work of a brilliant English investigator, Mr. G. H. Drew, whose recent death has deprived marine biology of one of the most original and fertile workers, and to whose memory the director of the department, Mr. A. G. Mayer, contributes a sympathetic and appreciative notice. Drew's memoir deals with the action of denitrifying bacteria in the tropical seas, and also with the precipitation of calcium carbonate by marine bacteria. Though necessarily incomplete, the results are a fine contribution to the difficult subject of marine bacteriology. They show that the reason why marine plankton is less abundant in the tropics than in temperate seas lies in the rapid and complete action of the denitrifying organisms in the warmer parts of the ocean; and Drew was able also to point to the extraordinary interest and importance of *Bacterium calcis* in inducing such precipitation of the calcium carbonates as to give rise to nodules of chalk. He suggests that chalk and oolitic rocks have been formed in shallow seas and are being produced round the Bahamas by this peculiar bacterial action.

[1] Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. v. Pp. 222+plates+maps. (1914)

This mode of rock origin was suggested by Dr. Wayland Vaughan in 1912, and he contributes a further paper on the subject, and on the geology of the Bahamas in the present volume. It appears therefore as a companion paper to the work of Drew, and both should be read by those who wish to realise how bacteriology and marine research are throwing light on the problems of geology. Dr. Vaughan also contributes a memoir on the origin of the coral reefs on the Florida coast with especial reference to the origin of the atolls of that district. His main conclusion is that atolls are formed "not by solution of an interior mass of limestone, but by constructional geologic processes."

Careful systematic studies of the Polyzoa of the Tortugas Islands and of Jamaican Echinoids have been made, and the result should be of interest to systematists. Of more general importance is a study of mammalian spermatogenesis, curiously out of place in a publication of this kind, and therefore likely to be overlooked by workers on this subject. Prof. H. E. Jordan, who contributes this paper, comes to the conclusion that in several mammals examined the spermatozoa are not all alike, but, as in certain other groups of animals, fall into two classes. Amongst the mammals exhibiting this important peculiarity are white mice, sheep, horse, mule, bull, and dog. In man the evidence is at present contradictory and difficult properly to assess. The importance of this subject lies in its bearing on the theory of sex determination.

The last paper we have space to refer to concerns the habits and power of regeneration in sea-fans or Gergonians, a group of corals which have been little studied in a living state. The establishment of a marine laboratory in the tropics now permits these and many other neglected subjects to be more fully investigated, and under the directorship of Dr. A. G. Mayer there is every reason to believe that important biological advances will be made.

TERMITES AND THEIR HABITS.

TWO interesting papers on termites and their habits, by Mr. T. Petch (reprinted from the *Annals* of the Royal Botanic Gardens, Peradeniya, November, 1913), have reached us. The author has already made a special study of the fungi which grow in termite nests, and not only serve as food for the insects, but are also frequently cultivated by the latter, and undergo remarkable changes in form and mode of growth as the result. The first paper deals with a supposed association of white ants with a mushroom-like fungus, and though the facts are not yet definitely established, it would seem probable that after a period of cultivation in the termite nest this fungus loses its vigour, and in order to remedy this defect the termites carry spherical masses of the fungus up to the surface and plant them out in places where they will develop spores, which the termites convey back to the nest as "seed" for a new fungus crop.

The second paper is an extended study of the habits of the Ceylon black termite (*Eutermes monoceros*), which usually builds its nest in hollow trees. The nest contains a single comb, and consists of thin, tortuous plates, irregularly united to form a sponge-like mass with wide passages separated by thin walls; its substance is composed of excrement, fragments of the epidermis of various plants, fungus threads, and spores, and crystals, and the same mixture is found in the stomachs of the workers and soldiers. After describing the process of nest-building, the remarkable organised foraging processions, etc., the author states that lichens form the staple food of the black termite, and that they prefer lichens with loose texture and powdery surface (crustaceous lichens); they prefer algæ, but as the supply of these is small in comparison with the extensive growths of lichens on tropical trees, they evidently eat the lichens for the sake of the contained algæ, and not the fungal constituent, since they rarely touch fungi even when no other food is available.

THE AUSTRALASIAN ANTARCTIC EXPEDITION, 1911–14.[1]

THE object of the expedition was to investigate the Antarctic regions to the southward of Australia, a locality where the hypothetical Antarctic Continent was supposed to extend far to the north, but concerning which only the most meagre information was at hand. Most of the expeditions of late years have had as their objective the South Pole. Consequently, in order to secure the most promising route, their geographical fields have much overlapped, and the area of the unknown has not diminished commensurably with the magnitude of those undertakings.

There is still a vast unknown at the southern extremity of the globe, and, now that the Pole is reached, it is hoped, in the interests of science, that no further consideration will arise to cause future expeditions to follow upon each other's tracks, until at least a superficial knowledge of the whole has been attained.

It was our intention to land several self-contained wintering parties at widely separated points between longitude 90° E. and 150° E., each to make continuous scientific records at the base-station, and to investigate the surrounding region by sledge journeys. On the southward voyage, a party was also to be left at Macquarie Island, a little-known possession of the Commonwealth. Wireless telegraphy was to be used for the first time in Polar exploration, our Macquarie Island station transmitting Antarctic news to Hobart.

The vessel selected and fitted for the work was the *Aurora*, with a carrying capacity of about 600 tons.

The ship sailed from Hobart on December 2, 1911.

Macquarie Island, a sub-Antarctic possession of Tasmania, situated in the same latitude as South Georgia, was sighted on December 11. There exists there but one main island around the shores of which are many rocky reefs and islets. Rocks also appear for many miles to the north and south rising from a submarine ridge, which is the submerged continuation of the main island itself. The habitable island has a length of more than 20 miles and greatest breadth of 3½ miles. The chief vegetation is tussock grass and Kerguelen cabbage, but it abounds in a truly wonderful population of birds and animals.

At one time the island was a favourite haunt of the valuable fur seal, but for fifty years or more only odd specimens have been seen. The ruthless slaughter of the early sealers is responsible for this almost complete extermination. Sea elephants, however, are numerous, the bulls being met with up to 20 ft. in length and weighing probably some 2 tons.

Very little accurate information was known concerning the island, and the only available map preceding Blake's survey was a sketch made by a sealer. Rumours of the existence of wingless parrots and other continental forms of life indicated that perhaps Macquarie Island was the last remaining summit of a vast sunken southern land. Other evidence also suggested that probably at one time such a land existed uniting Australia with the Antarctic Continent. There was, indeed, an interesting field for scientific work.

Steaming south from Macquarie Island, the first ice

[1] From a paper read before the Royal Geographical Society on June 9 by Sir Douglas Mawson.

was met in lat. 64° S., and in lat. 65° 40′ S., the pack became impenetrable.

Progress to the south was made when the conditions permitted. During the afternoon of January 6 an ice cliff loomed up ahead, extending to the horizon in both directions. This proved to be an immense barrier tongue—afterwards named the Mertz glacier—pushing 60 miles out to sea from a great ice-capped land. This land, along which we steamed during the next two days, had never before been seen. Its continuity with Adelie Land was subsequently proved, and it was then decided to include our new discoveries under the same title.

The land rose up everywhere from the sea to form a plateau. Only rarely did portions of the rocky platform break through the ice-sheet. Numerous rocky islets fringing the coastline were a notable feature, and these formed admirable breeding grounds for marine birds.

At a point some miles from the nearest portion of D'Urville's Adelie Land a suitable spot was discovered for a wintering station. This was a rocky outcrop, a little more than a mile in extent, henceforth known as Cape Denison. In this locality rocks projected from under the ice-sheet within a sweeping indentation of the coastline, which we named Commonwealth Bay.

Although summer was at its height, the weather proved little better than a succession of gales directed off the land, veering between south and south-east. This state of things greatly hindered landing operations. We were fortunate in finding an excellent boat harbour at Cape Denison, between which and the ship the invaluable motor launch continually plied whenever the weather was propitious. By January 19 the whole of the stores and gear of the main base were transferred to the shore.

The *Aurora* steamed west for a day along the coast seen by D'Urville and Wilkes in 1840, until the limit of open water was reached. This stretch of navigable water we named the D'Urville Sea. Later we discovered that its freedom from ice is due to the persistent gales setting off the land in that locality.

The coast of Adelie Land could be traced in a westerly direction, but, on account of heavy pack, the vessel could not follow along the coast, the only course being to skirt the heavy ice to the north and west. At this point Capt. Davis expected to sight the high land reported by the United States Squadron (1840) as lying to the west and south-west, but no land was seen.

In long. 132° 30′ E., they were able to stand south again and shortly afterwards passed over the charted position of D'Urville's Côte Clarie. Quoting from Capt. Davis's report: "The water here was clear of pack ice, but studded with bergs of immense size. The great barrier which had been followed for 60 miles by the French ships in 1840 had vanished—nothing remained to mark its former position except a collection of huge bergs.

"At 10 a.m., having passed to the south of the charted position of Côte Clarie, we altered course to S. 10° E. true. Good observations placed us at noon in 65° 2′ S. and 132° 26′ E. with a sounding of 160 fathoms on sand and small stones. We sailed over the charted position of land east of Wilkes' Cape Carr, the weather was clear and there was no trace of land to be seen in this locality."

A few hours afterwards, still steaming south, new land was sighted to the south—icy slopes rising from the sea similar to those of Adelie Land, but of greater elevation.

To this discovery we gave the name of Wilkes Land, to commemorate the name of a navigator whose daring was never in question, though his judgment as to the actuality of *terra firma* was untrustworthy.

It was not until noon on January 31 that the atmosphere was sufficiently clear to see any distance. The ship was then pushing south amongst heavy pack ice in the vicinity of Sabrina Land. A portion of Balleny's Sabrina Land was sailed over, and there was no indication of land in the vicinity. Finally a point was reached 7 miles from a portion of Wilkes's Totten's Land, reported to be high land. A sounding gave 340 fathoms. The weather was clear and high land would have been visible at a great distance. It was therefore apparent that Totten's Land either does not exist at all or is situated some distance from its charted location. The pack was too heavy for the ship to penetrate further to the south, so a course was set to the west. Heavy pack barred the way to the south.

Some days after, the vicinity of Knox Land, of Wilkes' charts, was reached. With the exception of Adelie Land, which the French sighted some days previous to the Americans, the account by Wilkes concerning Knox Land is more convincing than any of his other statements relating to new land.

If not already disembarked, we had counted on settling our Western Base in this place. It was, therefore, very disappointing when heavy pack ice barred the way, at a point still north of Wilkes's furthest south in that locality. Repulsed from his attack upon the pack ice in that vicinity, Captain Davis decided to go still further west. The course made carried the ship to the north-west. Early on the morning of February 8, in foggy weather, a wall of ice about 80 ft. high appeared across the bows extending in a north-westerly direction. Following this along, the weather cleared, and it was recognised to be the face of an extensive flat-topped mass of floating ice. Rounding a cape to the west, and passing through loose ice, open water was reached to the south. Fifty miles in that direction the sea was found to shallow rapidly and a maze of large grounded bergs was entered. The bottom was found to be very regular, ranging between 110 and 120 fathoms.

The last of the obstructing ice was negotiated on February 13, and the ship steamed into a broad sheet of water still stretching to the south. This open sea inside the pack-ice belt we ascertained, later, to be a permanent feature of that vicinity, and to it I gave the name of the Davis Sea, after the intrepid captain of the *Aurora*.

One hundred miles further to the south, in lat. 66° S. and long. 94° 23′ E., the icy slopes of new land were seen extending east and west as far as the eye could reach. The sphere of operations of the German Expedition of 1902 was now near at hand, for their vessel, the *Gauss*, had wintered frozen in the pack about 125 miles to the west. The land to the south, which the Germans visited by sledge journey over the pack ice, was eventually proved by one of our own sledging parties to be continuous with the new land now sighted by the *Aurora*. The "high land" in the direction of Wilkes's Termination Land, seen by the Germans during a balloon ascent, we found to be a high ice-sheathed island about nine miles in diameter. To this we gave the name of Drygalski Island. The position marked for Termination Land on Wilkes's charts we found to be occupied by pack-ice and a barrier-ice formation (marginal shelf ice).

The formation in question, trending about 180 miles to the north from the newly discovered land just referred to, was found to be very similar in character to the well-known Ross Barrier over which lay part of Scott's and Amundsen's journeys to the south pole This we named the Shackleton Ice Shelf. Its height is remarkably uniform, ranging between 60 and 1[illegible]0 or more feet. Making allowance for the average specific gravity, this indicates an average total thickness of perhaps 600 ft. In area it occupies many thousands of square miles.

This wonderful block of ice originates fundamentally from the glacier-flow over the great plateau-land to the south. Every year an additional layer of consolidated snow is added to its surface by the frequent blizzards. These annual additions are clearly marked on the dazzling white face near the brink of the ice-cliff. However, there is a limit to this increasing thickness, for the whole mass is ever moving slowly to the north, driven by the irresistible pressure of the land-ice behind. Its northern face is crumbling away before the action of the sea, breaking down into bergs and brash-ice.

Its present limits are, no doubt, in a state of temporary equilibrium, in which the crumbling keeps pace with the yearly advance. During the third voyage of the *Aurora*, we had the unique experience of witnessing this crumbling actively at work. This happened as we were steaming along within 300 yards of the cliff face. Suddenly a mass weighing perhaps a million tons broke away, first sinking down into the sea. Then followed an interval of a few minutes, during which it majestically rose and sank alternately accompanied by a rapid splitting up. At the end of five minutes only small bergs and brash-ice remained.

A position for the landing of the western party was chosen on the Shackleton ice shelf. The spot selected was about seventeen miles from the land itself—the nearest approach possible by the ship.

At the main base station in Adelie Land, the hut was quickly erected and self-recording instruments housed and set running without delay. The average wind velocity in Adelie Land proved to be far beyond anything previously known. The charts of the self-recording instruments show the average for the whole year to be fifty miles an hour. Average hourly velocities of one hundred miles and more were common, and twenty-four hourly averages of more than ninety miles were recorded. Frequently the air travelled forward in a series of cyclonic gusts, near the foci of which momentary velocities were reached very much higher than the averages mentioned. Thus, pebbles were lifted and structures not buried in the *névé* thrown down.

Fortunately, the hut was soon drifted over to such an extent that only a portion of the roof remained above ground. Entrance to the interior was effected in fine weather by a trap-door in the roof; at other times through tunnels in the *névé*.

For months the drifting snow never ceased, and intervals of many days together passed when it was impossible to see one's hand held at arm's length. The drift-snow became charged with electricity, and in the darkness of the winter night all pointed objects and often one's clothes, nose, and finger-tips glowed with the pale blue light of St. Elmo's fire. Add to this, the force exerted upon the body, the indescribable roar of the hurricane, the sting of the fury-driven ice particles, and the piercing cold, and some idea is got of the conditions under which the routine of outdoor observations was maintained. Such weather lasted almost nine months of the year. Even in the height of summer, blizzard followed blizzard in rapid succession.

It was not until November 7 that there was sufficient moderation in the weather for a final start. Five diverging parties worked simultaneously, so that a maximum of new ground was covered during the comparatively short sledging season.

The Near-East Journey.—Stillwell, assisted by Close and Laseron, mapped in the coastline to the east as far as the Mertz Glacier. Stillwell's map illustrates the immense number of rocky islets that fringe the mainland in that vicinity. There silver petrels, Antarctic petrels, Wilson petrels, snow petrels, cape pigeons, etc., were found nesting in large colonies.

The Eastern Journey.—Further east Madigan, assisted by McLean and Correll, continued the work, reaching 67° 14′ S. lat., and 150° 21′ E. long. Eastward of the Mertz Glacier they found the sea frozen, and travelled over it for the remainder of the journey, crossing the fifteen miles wide tongue of the Ninnis Glacier and visiting several headlands by the way. In the vicinity of the Horn Bluff there is a sweep of coastline bounded by rocky cliffs, 1000 ft. high. There they discovered coal and carbonaceous shales outcropping at an elevation of several hundred feet, associated with Red Sandstone and capped by an immense thickness of columnar dolerite. Madigan made frequent determinations of magnetic dip and azimuth. Nearer to winter quarters only gneiss and schists are exposed. The new land east of the Mertz Glacier we have received his Majesty's gracious permission to name King George V. Land.

The Far-East Journey.—It was across King George V. Land that Ninnis, Mertz, and I made the sledging journey that ended so unfortunately in the deaths of my two companions. It was our intention to cross rapidly the coastal highlands to the south of the tracks of Madigan's party, and to pick up the coast beyond where they could expect to reach. On December 14, when we had travelled outwards 311 miles, and were crossing the coastal highlands in 68° 54′ S. lat., 151° 33′ E. long., Ninnis, with his dog team and sledge, broke through the roof of a *névé*-covered crevasse and fell into an unfathomable depth below. About midnight on January 7–8 Mertz passed away, after having been in a delirious and unconscious state for some hours.

My own condition was such as to hold out little hope, but I determined to push on to the last, anticipating that at least a record might be left near Aurora Peak, a place likely to be visited by search parties. On January 11, after spending three days, during which particularly bad weather prevailed, in arranging everything to facilitate forward progress, I resumed the march alone. After three weeks' creeping forward wherein most providential escapes from crevasses were experienced, I had the good fortune to stumble upon a cache of provisions. Stimulated by good food, the march was resumed. Eventually the $5\frac{1}{2}$ mile cave was reached. Then a strong blizzard, reaching a velocity of eighty miles an hour caused further delay. The wind fell off on February 8. Descending the ice slopes to the hut, the *Aurora* was visible on the horizon, outward bound.

The Southern Journey.—Of summer sledging parties from the main base, one was led by Bage to the south, inland over the plateau, and another led by Bickerton over the highlands to the west. Bage's companions were Webb and Hurley. Murphy, Hunter, and Laseron formed a supporting party accompanying them for sixty-seven miles. After leaving the coast no sign of rock was seen, their track lying over a desolate wind-swept plateau. The wind seldom ceased, and drifting snow was the rule. This constant flow of air has cut in the plateau surface deep sastrugi, of such dimensions as are not met with elsewhere. Over those obstacles they dragged their sledges into the face of the wind for 300 miles out from the hut, to a point within a few miles of the magnetic pole. There an elevation of 6500 ft. was reached. On one occasion they made a march of forty miles. The magnetic data from that journey are particularly valuable, for Webb took full sets of observations for dip and azimuth at regular intervals.

The Western Journey.—Hodgeman and Whetter, with Bickerton, formed the western party. The western journey was conducted for the most part at an elevation of about 4000 ft., and proved very dreary. Wind and drift were the rule, notwithstanding the fact that it was then the height of summer. The average wind velocity for the period of the whole journey, as calculated from the daily records, was thirty-four miles an hour.

The party passed over the highlands of the Adelie Land seen by D'Urville, coming close to the coast in lat. 66° 35′ S. long., 137° 58′ E., where they saw frozen sea to the west. One of the points of special interest connected with this journey was the finding of a piece of rock[2] a pound or two in weight, lying on the surface of the inland ice sheet far from any nunataks.

Seven of us remained in Adelie Land for a second year. Wireless communication was established with Macquarie Island about the middle of February, 1913, and we were able to apprise the world of the happenings before even the *Aurora* herself had reached Hobart. The wireless proved a success and a boon throughout the year, though temporary stoppages, however, occurred, owing to unusual difficulties arising chiefly from the constant hurricane. For example, it was found difficult to keep the aerial up; difficult to hear the messages on account of the muffled roar of the wind; and often impossible to work on account of the heavy electrical discharge from the atmosphere.

On December 2, the *Aurora* arrived, picking up Ainsworth, Blake, Sandell, and Hamilton *en route*, to relieve us in Adelie Land. With them they brought three new men down to carry on the meteorological and wireless station on account of the Commonwealth Government, by whom the station is to be maintained in the future.

The result of the labours of Ainsworth and his party is that complete scientific information regarding Macquarie Island is now available. Besides the routine work, many new problems have arisen enriching biological, meteorological, and geological literature.

Commonwealth Bay was reached on December 13. Visits were paid to outlying islets, and a considerable programme of oceanographical work and dredging on the continental shelf carried out. Steaming westwards, a new addition was made to the western extremity of Adelie Land. Oceanography and an examination of the Shackleton ice shelf occupied us until February 7, when the pack was finally left behind. On the return journey a line of soundings was secured, completing a section of the ocean floor between Western Australia and Queen Mary Land. Adelaide was reached on February 26, 1914.

SUMMARY OF SCIENTIFIC OPERATIONS.

I. TERRESTRIAL MAGNETISM.

A. *Field Work.*

(*a*) Dip determinations at Macquarie Island, on the eastern and southern journeys from the main base, and on a short journey from the western Antarctic base.

(*b*) Declination by theodolite observations was determined at Macquarie Island and at intervals on all sledging journeys in the Antarctic.

(*c*) Rough observations made daily on the ship.

B. *Station Work.*

(*a*) Regular magnetograph records were kept at the main base for a period of eighteen months. A system of term days for quick runs was also followed; Melbourne, Christchurch, and other stations cooperating. In connection with the magnetograph work, Webb conducted regular absolute observations throughout the year. His work was admirably done in the face of remarkable difficulties in the matter of weather.

(*b*) At the western base Kennedy kept term days through the winter, using a magnetometer and dip circle.

BIOLOGY.

1. *Station Collections.*

(*a*) At Macquarie Island, Hamilton worked for two years amongst a rich fauna. The forms discovered are not merely those of oceanic types; amongst other things a new native finch has been discovered.

(*b*) At the main base, Hunter, assisted by Laseron, secured a large collection, notwithstanding the obvious disadvantage of bad weather. Dredgings down to 50 fathoms were made during the winter. The eggs of practically all the flying birds known on Antarctic shores were obtained, including those of the silver-grey petrel and of the Antarctic petrel not before known; also a bird and its eggs of an unrecorded species.

(*c*) At the western base, the eggs of the Antarctic and other petrels were obtained, and a large rookery of Emperor penguins located. Harrison did a little marine work from floe, working with inadequate gear in 250 fathoms of water. In this way he succeeded in trapping some interesting fish.

2. *Ship Collections.*

(*a*) A collection made by Mr. Waite on the first sub-Antarctic cruise.

(*b*) A collection made by Prof. Flynn on the second sub-Antarctic cruise.

(*c*) A collection made by Hunter, assisted by Hamilton, in Antarctic waters during the summer of 1913–14. This comprises a number of deep-sea dredgings working down to 1800 fathoms, also regular tow-nettings, frequently serial, to depths of 200 fathoms. Six specimens of the rare Ross seal were secured.

GEOLOGY.

(*a*) A geological examination of Macquarie Island by Blake. The older rocks were found to be all igneous. The island has been overridden comparatively recently by an ice-cap travelling from the west.

(*b*) Geological collections at the main base. In Adelie Land the rock outcrops are metamorphic sediments and gneisses. In King George V. Land there is a formation similar to the Beacon sandstones and dolerites of the Ross Sea. Carbonaceous shales and coaly strata are associated with it.

(*c*) Stillwell collected a fine range of minerals and rocks from the terminal moraine at winter quarters. Amongst them is abundance of red sandstone, suggesting that the Beacon sandstone formation extends also throughout Adelie Land, but is hidden by the ice-cap.

(*d*) Collections by Watson and Hoadley at the western base. Again gneiss and schists are the dominant features

(*e*) A collection of erratics brought up by the dredge in Antarctic waters.

[2] This rock is quite unusual in appearance and may prove on examination to be a stony meteorite.

GLACIOLOGY.

(*a*) Observations on the pack-ice.
(*b*) Observations on sledging journeys of the inland-ice.
(*c*) Observations on the coastal glaciers, tongues, and shelf-ice.

METEOROLOGY.

(*a*) Two years' observations at Macquarie Island by Ainsworth.
(*b*) Two years' observations at Adelie Land by Madigan.
(*c*) A year's observations at Queen Mary Land by Moyes.
(*d*) Ship's observations on each of the voyages.
(*e*) Observations on sledging journeys.

BACTERIOLOGY.

In Adelie Land Dr. McLean carried out many months of steady work.

TIDES.

Self-recording instruments were run at Macquarie Island by Ainsworth, and at Adelie Land by Bage.

WIRELESS AND AURORAL OBSERVATIONS.

Very close watch was kept upon auroral phenomena with interesting results, especially in their relation to the permeability of the æther to wireless waves.

GEOGRAPHY.

(1) The successful navigation by the ship of the Antarctic pack-ice in a fresh sphere of action, where the conditions were practically unknown. This resulted in the discovery of new lands and islands.

(2) Journeys have been made over the sea-ice and the continental plateau in regions never before sledged over. At the main base journeys aggregating 2400 miles were made, and at the western base journeys of 800 miles. These figures do not include depôt journeys, supporting parties, or relay work. The land has been followed through 33° of longitude, 27° of which were covered by sledging parties.

(3) The fixing of a fundamental meridian in Adelie Land, using wireless telegraphy.

(4) By soundings the continental slopes, and in most cases the shelf itself, have been indicated through 55° of longitude.

(5) The mapping of Macquarie Island.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—Mr. T. B. Abell has been appointed to the Alexander Elder chair of naval architecture, rendered vacant by the resignation of his brother, Prof. W. S. Abell.

LONDON.—The University College Committee will shortly proceed to appoint a lecturer and demonstrator in anatomy at a salary of 350*l*. Applications must reach the secretary of University College on or before July 11.

MANCHESTER.—Dr. Niels Bohr, of the University of Copenhagen, has been appointed reader in mathematical physics. For some time Dr. Bohr was engaged in research in the physical department of the University of Manchester, and has made a close study of mathematical physics. He has contributed a series of important original papers on the constitution of atoms, molecules, and the origin of spectra. This work has attracted much attention, and has formed the starting point of numerous research now in progress.

SHEFFIELD.—The council of the University has appointed Mr. H. J. W. Hetherington to the post of lecturer in philosophy, in succession to Mr. T. Loveday, resigned.

ON their way home from Australia, the following men of science who are attending the British Association meeting, will, the *Pioneer Mail* states, lecture on the subjects named for the University of Calcutta:—Prof. H. H. Turner, on pure mathematics; Prof. Ernest W. Brown, on applied mathematics; Prof. H. E. Armstrong, on chemistry; Prof. W. M. Hicks, on physics; and Prof. W. Bateson, on biology.

WE have received the Livingstone College Year Book for 1914. This college, which has now reached its twentieth session, is doing good work in giving a training in the elements of medicine and first aid to missionaries. The principal, Dr. Harford, has resigned, after twenty-one years' service, and Dr. Loftus Wigram has been appointed to succeed him. An appeal has been issued for 10,000*l*. in order to clear off the debt and to effect improvements to the college property.

WE learn from *Science* that the Sheffield Scientific School, Yale University, has received a provisional gift from one of its graduates of 20,000*l*. This gift is contingent upon an additional 20,000*l*. being secured. From the same source we learn that the Gustavus Adolphus College, St. Peter, Minnesota, has completed an endowment fund of 50,000*l*. The two largest contributors were Mr. J. J. Hill, of St. Paul, and Mr. C. A. Smith, of Minneapolis, each of whom gave 10,000*l*.

IN reply to questions asked by Sir Philip Magnus in the House of Commons on June 29, Mr. Pease said that the Government certainly contemplates the reconstitution of the University of London, but not a new London University, distinct and separate from the present University. Mr. Pease does not suppose the Departmental Committee appointed to frame a Bill to give effect to the recommendations of the Royal Commission on University Education in London will be able to submit its report before the close of the session.

ON the occasion of the tercentenary of the founding of Groningen University, the following honorary degrees have been conferred:—*Doctor of Medicine*, Sir Edward Schäfer (Edinburgh) and Prof. J. N. Langley (Cambridge); *Doctor of Letters*, Prof. W. M. Lindsay (St. Andrews) and Principal Peterson (McGill University, Montreal); *Doctor of Dutch Letters*, Prof. A. S. Napier (Oxford); *Doctor of Geology and Mineralogy*, Dr. A. L. Day (Washington); *Doctor of Botany and Zoology*, Prof. S. J. Hickson (Manchester); and *Doctor of Political Science*, Lord Reay and Mr. Carnegie.

IT is announced in the issue of *Science* for June 12 that Mr. Andrew Carnegie has added, presumably from the income of the Carnegie Corporation, 400,000*l*. to the endowment of the Carnegie Institute of Pittsburgh, to be equally divided between the institute and the school of technology. Mr. Carnegie's gifts to these institutions now amount to 4,800,000*l*. From the same source we learn that by the will of the late Judge J. F. Dillon, Iowa State University receives 2000*l*. and Iowa College and Cornell College 200*l*. each. An additional gift of 5000*l*. has been received by Oberlin College for carrying out the general building plans and the improvement of the grounds. The old students of the University of Illinois are planning to erect a 30,000*l*. building as a memorial to Dr. J. M. Gregory, first president of the University.

THE Board of Agriculture and Fisheries proposes to award the following scholarships, tenable for three years from October 1 next. Three agricultural science scholarships of the value of 150*l*. per annum, open to students who have graduated with honours in science at a British University; two veterinary research scholarships of the value of 150*l*. per annum, open to students who have obtained the diploma of the Royal College of Veterinary Surgeons; three veterinary scholarships of the value of 100*l*. per annum, open to students who have graduated with honours in science at a British university, and tenable for three years at a veterinary college in the United Kingdom. Applications for any of the foregoing scholarships must be made not later than July 17, on a form to be obtained on application from the secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

THE Education Committee of the London County Council has recently had under consideration the recommendations of the Royal Commission on University Education in London. Two questions in particular have received careful attention: the constitution of the governing body of the University and its relation to the teaching institutions, and in particular to the Imperial College of Science and Technology; and the provision to be made for the education and examination of persons who are unable to devote their whole time to study. The committee approves generally the proposals of the Commission with reference to the government of the University of London, and is of opinion that no scheme for the reorganisation of the University will be satisfactory which does not provide that the Senate shall have full and effective control over the work of the University in the constituent colleges. The committee considers it essential that the Imperial College of Science and Technology shall become a constituent college of the University. It is also of opinion that the University of London should continue to confer degrees in honours as well as ordinary degrees on all British subjects in all faculties other than the faculty of medicine on the results of examination only, without regard to the course of training the candidate has pursued, or in the case of the higher degrees, on the submission of original work.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, June 9.—Prof. E. A. Minchin, vice-president, in the chair.—P. D. **Montague**: Report on the fauna of the Monte Bello Islands. The islands are barren limestone with a limited vegetation and some mangroves. The collections prove conclusively the entire dependence of the islands for their fauna on the neighbouring continent. Partial depopulations of the islands owing to drought are suggested, succeeded by repopulations by means of wind-borne forms from the south.—Dr. W. A. **Cunnington**: Parasitic Eucopepoda collected by the third Tanganyika Expedition in 1904–5. The collection consisted of a very small number of specimens, these forms being evidently much rarer than the Argulidæ, which are also external parasitic Copepods infesting fish.—Dr. F. E. **Beddard**: A new species of avian Cestodes and a further discussion of the paruterine organ in Otiditænia.—R. I. **Pocock**: The facial vibrissæ of mammalia. In all the principal orders of the class, with one or two exceptions, the following groups of vibrissæ are present in some genera:—Mystaciale on the upper lip, submental on the chin and lower lip, superciliary over the eyes, gonal on the cheeks, and interramal on the throat behind the symphysis of the jaw. Within the limits of the orders these tufts are present in the primitive genera, but more or fewer of them may be lost in the more specialised types. This fact, coupled with their prevalence in widely different types, points to the arrangement of the vibrissæ above indicated being exceedingly primitive.—R. I. **Pocock**: The feet and other external features of the Canidæ and Ursidæ. The paper dealt with the rhinaria, the facial vibrissæ, and the pads and interdigital integument of the feet in many of the genera of Canidæ and all the admitted genera of Ursidæ.—Dr. G. A. **Boulenger**: A second collection of batrachians and reptiles made by Dr. H. G. F. Spurrell in the Choco, Colombia.—D. M. S. **Watson**: *Procolophon trigoniceps*, a cotylosaurian reptile from South Africa.—A. W. **Waters**: Marine fauna of British East Africa and Zanzibar, from collections made by Cyril Crossland in the years 1901–2: Bryozoa—Cyclostomata, Ctenostomata, and Endoprocta. Out of the twenty-four species from these three groups, four are new; and, as the species mentioned are all from 10 fathoms or under, it will not occasion surprise that the number of Cyclostomata is but small.

Physical Society, June 12.—Prof. T. Mather, vice-president, in the chair.—Prof. C. H. **Lees**: Note on the connection between the method of least squares and the Fourier method of calculating the coefficients of a trigonometrical series to represent a given function or series of observations. In view of the number of alternative methods which have been suggested for calculating the coefficients of the terms of a Fourier series to represent a number of observations of a variable quantity, the author points out that the Fourier method gives the most probable values of the coefficients, since it makes the sum of the squares of the errors at the points of observation a minimum.—F. E. **Smith**: A magnetograph for measuring variations in the horizontal intensity of the earth's magnetic field. In the case of unifilar instruments for recording variations in H, if θ is the angle which the magnetic system makes with the magnetic meridian, M the moment of the magnet, and H the horizontal intensity of the earth's field, equilibrium results when when $MH \sin \theta = T\phi$, where ϕ is the torsion on the fibre and T is a constant. In the instrument described ϕ may be made great or small, but high sensitiveness is secured by making ϕ great.—G. **Shrimpton**: The atomic weight of copper by electrolysis. Four copper cells separating two silver cells were run in series. The areas of the four copper kathodes increased from 10 to 50 s.cs. By plotting the weights of the copper deposits against the corresponding areas of the kathodes, and extrapolating to zero area, the weight of the deposit is corrected for under experimental conditions. The atomic weight of copper

$$= \frac{\text{corrected weight of Cu}}{\text{mean weight of Ag}} \times 107 \cdot 88 \times 2.$$

The mean atomic weight for ten determinations + 63·563, with a mean error of ±0·003.—W. H. **Apthorpe**: Note on an improvement in the Einthoven string galvanometer.

Mineralogical Society, June 16.—Dr. A. E. H. Tutton, president, in the chair.—Dr. J. **Drugman**: Childrenite from Crinnis mine, Cornwall, and eosphorite from Poland, Maine. Analyses of childrenite from Crinnis mine showed it to contain even less manganese than the specimens from George and Charlotte mine. Eosphorite from Poland is richer in manganese than that from Branchville, the only occurrence previously known. It is well crystallised, unlike the Crinnis mine childrenite.—R. H. **Solly**: Sartorite. From a goniometrical examination of two hundred crystals it is concluded that Dr. Trechmann's crystals, Nos 1 and 2, belong to a new species closely allied to sartorite and smithite. Many new forms for sartorite were found.—Dr. G. T. **Prior**: Re-determination of nickel in the Baroti and Wittekrantz meteorites. Precipitation with ammonia was found not to separate iron from nickel completely, however often the operation was repeated. Re-determination showed that the proportion of iron to nickel in the case of both the meteorites in question was nearer 6 : 1 than 10 : 1, as previously stated.—Dr. L. L. **Fermor**: Ice crystals from Switzerland. Last winter the surface of the snow in shady situations near Zweisimmen and Lenk was often characterised by a dense growth of hollow prisms formed of a thin shell of ice coiled spirally parallel to the face of a hexagonal prism.—Dr. L. L. **Fermor**: Hematite from the Kallidongri manganese mine, India. The crystals, which had the habit of corundum, and were marked with three sets of striations due to twin lamellation parallel to 100, showed the forms 111 and 61$\bar{4}$ well developed, together with 100, 22$\bar{1}$, 28.28.13 (a new rhombohedron), 51$\bar{3}$, 71$\bar{5}$, and 10$\bar{1}$, less prominent.—H. B. **Cronshaw**: A variety of epidote from the Sudan. A mineral discovered by Mr. G. W. Grabham in a pegmatite vein closely resembles allanite in appearance, but is free from rare earths and agrees in composition with epidote; in its pleochroism and negative sign it also resembles the latter, but has an abnormally low optic-axial angle of about 54°. In thin section it presents a well-marked zonal structure.

Royal Meteorological Society, June 17.—Mr. C. J. P. Cave, president, in the chair.—B. C. **Wallis**: The rainfall of the southern Pennines. This inquiry had been undertaken with the view of attempting to find a scientific justification of the claim made for the wetness and humidity of Lancashire suitable to the manufacture of cotton. In summarising the distribution of the rainfall of the Pennine district, the author said it may be asserted that the west is wetter than the east on the whole and as a rule, although the difference between the two areas is least marked during the dry season from March to May. In June and July, however, the lowland of the Trent and Ouse valleys receives a relative excess of rainfall which is compensated by the relative dryness in December and January. The uplands are absolutely wetter than the neighbouring lowlands, and the western slopes are wetter than the eastern slopes, but the difference in rainfall between upland and lowland is least marked during the warm weather and most marked during the cold weather. Throughout the whole district, on the average, the rainfall decreases in intensity from January until April, increases from April to August, shows a drop in relative quantity for September, rises to a maximum in October, and then declines until December. The local relief of the Pennine uplift gives to the cotton towns their characteristic climate, and is the dominant factor which has made Lancashire supreme in the cotton industry. —H. J. **Bartlett**: The relation between wind direction and rainfall. This was a discussion of wind and rain records at the four observatories Valencia, Aberdeen, Falmouth, and Kew for the ten-year period 1901–10. It was shown that a large proportion of the total rainfall falls with winds in the south-east and south-west quadrants, except in the case of Aberdeen, where the amount in the north-west quadrant is relatively high. The greatest amounts at Kew and Falmouth are, with a south-west wind, respectively 22 and 28 per cent. At Aberdeen the south-east wind brings the highest amount, 20 per cent., while Valencia receives 30 per cent. with south, 20 per cent. with south-east, and 15 per cent. with the south-west wind during the year. At each observatory there are two months during the year when the proportion of rain occurring normally in one or more quadrants diminishes considerably. For Valencia, Falmouth, and Kew this feature is strongly marked in June and September, while for Aberdeen, where it is less obvious, the months are May and November.—E. H. **Chapman**: Barometer changes and rainfall: a statistical study.

Paris.

Academy of Sciences, June 22.—M. P. Appell in the chair.—G. **Humbert**: Some remarkable numerical functions.—J. **Boussinesq**: The mean velocity, or the flow and the maximum or axial velocity, in a prismatic tube, of regular section with any number (m) of sides. —H. **Deslandres** and V. **Burson**: The exact study of band spectra, the so-called Swan spectrum, in the magnetic field. The division and polarisation of the lines of the spectrum. The study of the Swan band spectrum has given results in general agreement with the work previously published on other band spectra. Comparing with line spectra the deviation of the Zeeman components is much smaller and the circular vibrations do not show the negative effect exclusively, but, nearly as often, the positive effect. These facts can be explained by assuming the presence of both positive as well as negative particles, of a mass much larger than the electron. A very powerful magnetic field is necessary in these researches.—Charles **Depéret**: The reconstitution of a skeleton of *Felsinotherium serresi*, from the Montpellier sands. A photograph is shown of the skeleton which has been reconstructed from the remains of several individuals. It is slightly longer than the present dugong.—P. **Chofardet**: Observations and remarks on the Kritzinger comet, 1914*a*, made at the Observatory of Besançon. Positions given for May 22, June 17 and 20. The peculiarities in the variations in magnitude of this comet are discussed.—Ch. H. **Müntz**: A property of Bernoulli's polynomials.—C. **Popovici**: A functional equation.—J. E. **Littlewood**: The distribution of the prime numbers.—Ludwig **Schlesinger**: Integro-differential equations.—K. **Bartel**: A geometrical method of formation of some ruled surfaces of higher order.—G. **Koenigs**: A new formula expressing the power indicated by a four-cycle motor as a function of the experimental elements. A recalculation of some results by M. Lumet.—Jacques **Duclaux**: The mechanism of light radiation and the entropy quantum.—F. **Bourcier**: The propagation of Hertzian waves along a wire wound as a helix.—A. **Defretin**: The Foucault currents in a soft iron core and the influence of hysteresis. The effective value of the mean induction for a given ring and magnetising current varies inversely as the square root of the frequency, if this is moderately large.—Otto **Scheuer**: A reduction of carbon monoxide by hydrogen caused by the radium emanation (see page 463).—Z. **Klemensiewicz**: The electrochemical properties of radium-B and thorium-B. The method is based on the determination of the distribution ratio of a radio-active body between an amalgam of the metal supposed to be isotopic with it and an aqueous solution of one of these salts. It was found that the normal electrolytic potentials $E_N = 0{\cdot}029 \log P$ of radium-B and of thorium-B are equal to that of lead within $2{\cdot}10^{-5}$ volt. This confirms the view that the radio-active metal and its isotope are chemically inseparable.—Victor **Henri**: Study of the dispersion of the ultra-violet rays by organic bodies. For the numerous organic substances studied it was found that for a wave-length up to about $\lambda = 2600$, the radio-active power of CH_2 is as additive as in the visible spectrum; for shorter waves the additivity subsists only as a first approximation.—Paul **Pascal**: The diamagnetic properties of the elements follow a periodic law.—H. **Pélabon**: The thermo-electric power of the selenides of tin. The curve representing the thermo-electric power of the tin-selenium alloys as a function of the composition shows a marked angular point corresponding with the compound SnSe, but there is no discontinuity at the composition $SnSe_2$.—R. **Cornubert**: The allyl*cyclo*hexanones and the methylallyl*cyclo*hexanones. A tabulated statement of the physical properties of nineteen substituted *cyclo*hexanones.—E. **Léger**: A new method of transformation of barbaloin into β-barbaloin. The conversion is readily effected by heating with acetic anhydride in the presence of sodium acetate.—E. **Gourdon**: The mineralogical constitution of the Southern Shetlands (Antarctic).—M. **Chouchak**: The influence of a continuous electric current on the absorption of nutritive substances by plants. Under the action of an electric current the velocity of absorption of nutritive materials by plants depends on the concentration of the nutritive materials and on the electric state of the roots of the plants. The facility with which the last factor can be altered has an important practical application on plant growth.—E. **Bataillon**: A reagent of activation and fecondation on the eggs of Batrachians cleaned with cyanide.—J. M. **Lahy**: The comparative effects on the blood pressure of physical fatigue produced by a long walk and psychical fatigue resulting from work requiring close attention. With soldiers performing long marches there is no notable increase in the blood pressure, but with work requiring concentrated mental attention there is an increase.—Mlle. G. **Koenigs**: Researches on the excitability of the motor pigment fibres.—J. E. **Abelous** and C. **Soula**: The modifications of the urine in anaphylaxy.—Pierre **Robin**: Circumduction cannot exist in temporo-maxillo-dental articulation.—Y. **Manouélian**: Cytological researches in human tetanus. A histological study of the modifications caused by tetanotoxin in the peripheral motor neurones.—J. **Tissot**: The function of the dissociation of soaps in the mechanism of the inactivation of serums by the addition of salts, dilute acids, carbonic acid, and globulin.—Edm. **Sergent** and H. **Foley**: The latent periods of the spirilla in the patient attacked by recurring fever. M. **Lécaillon**: The existence of phenomena of rudimentary natural parthenogenesis in the common toad, *Bufo vulgaris*.—L. **Bordas**: Propulsive vibration. Gliding and beating flight in birds.—Maurice **Piettre**: Crystallised tyrosine in microbial fermentations. The presence of tyrosine in the muscles or in other organs not normally containing products of digestion is an indication of putrefaction of the meat.—J. **Blayac**: The sands of the Landes in their relations with the Adour terraces. Contribution to the study of their origin and age.—Michel **Longchambon**: The distinction of the two secondary series of strata superposed in the neighbourhood of Vicdessos, Ariège.—E. **Maury**: The tectonic signification of the folds between Nice and Mentone.—Jean **Groth**: The tectonic of the Sierra Morena.

New South Wales.

Linnean Society, March 25.—Mr. W. S. Dun, president, in the chair.—R. J. **Tillyard**: The study of zoogeographical regions by means of specific contours, with an application to the Odonata of Australia.—H. J. **Carter**: Revision of the subfamily Tenebrioninæ (family Tenebrionidæ). Australian species: with descriptions of new species of Tenebrioninæ and Cyphaleinæ.

April 29.—Mr. C. Hedley, vice-president, in the chair.—L. **Kesteven**: The venom of the fish, *Notesthes robusta*. Tenison-Woods ("Fish and Fisheries of New South Wales," 1882, p. 48) has given a fairly accurate account of the symptoms following upon wounds inflicted by the spines about the head of this fish. The opportunity of treating professionally a number of cases of persons suffering from such wounds, has enabled the author to confirm and amplify Tenison-Woods's statements that the symptoms are not compatible with non-toxic wounds, but are undoubtedly venomous (contrary to the contention of Ogilby).—G. I. **Playfair**: Contribution to a knowledge of the biology of the Richmond River.—A. G. **Hamilton**: The xerophilous characters of *Hakea dactyloides*, Cav. (N.O. Proteaceæ).

Calcutta.

Asiatic Society of Bengal, June 3.—Dr. N. **Annandale** and S. W. **Kemp**: Fauna of the Chilka Lake in Orissa and Ganjam. The Chilka Lake is a shallow lagoon on the east coast of India, some thirty miles long and ten miles broad. It is connected with the sea by a narrow mouth which opens into a channel separated from the main body of the lake by a series of peninsulas and islands running parallel to the coast. The salinity of the water differs greatly at different seasons, but that of the outer channel is always much higher than that of the rest of the lake. The fauna consists of a mixture of marine and fresh-water types with a certain element that appears to be peculiar to brackish water.—Dr. E. P. **Harrison**: The "Gore effect" in iron. An anomaly in the expansion coefficient of iron at a dull red heat was discovered by Gore in 1869. The phenomenon is attributed to an obscure structural change in the metal and is probably closely associated with changes in magnetic quality and in electric resistance which are known to occur at high temperatures. A similar peculiarity affects the expansion coefficient of nickel.

BOOKS RECEIVED.

Ancient India. By Prof. E. J. Rapson. Pp. viii+199. (Cambridge University Press.) 3*s*. net.

Die Insekten Mitteleuropas insbesondere Deutschlands. Edited by Prof. C. Schröder. Band iii. Hymenopteren (Dritter Teil). Die Gallwespen (Cynipidæ). By Prof. J. J. Kieffer. Die Blatt- und Holzwespen (Tenthredinoidea). By Dr. E. Enslin. Pp. viii+213+8 plates. (Stuttgart: Franckh.) 7.20 marks.

Argyllshire and Buteshire. By P. Macnair. Pp. x+161. (Cambridge University Press.) 1*s*. 6*d*. net.

A Practical Handbook of the Tropical Diseases of Asia and Africa. By Dr. H. C. Lambart. Pp. xv+324+plates. (London: C. Griffin and Co., Ltd.) 8*s*. 6*d*. net.

The Examination and Thermal Value of Fuel: Gaseous, Liquid, and Solid. By J. H. Coste and E. R. Andrews. Pp. xvi+278. (London: C. Griffin and Co., Ltd.) 6*s*. net.

The Metallurgy of the Non-Ferrous Metals. By Prof. W. Gowland. Pp. xxvii+496. (London: C. Griffin and Co., Ltd.) 18*s*. net.

Tierbau und Tierleben in ihrem Zusammenhang betrachtet. By Profs. R. Hesse and F. Doflein. Band ii. Das Tier als Glied des Naturganzen. By F. Doflein. Pp. xv+960+plates. (Leipzig and Berlin: B. G. Teubner.) 20 marks.

A Reconstruction of the Nuclear Masses in the Lower Portion of the Human Brain-stem. By L. H. Weed. Pp. 76+vi plates. (Washington, D.C.: Carnegie Institution.)

The Climatic Factor, as Illustrated in Arid America. By Prof. E. Huntington and others. Pp. vii+341. (Washington, D.C.: Carnegie Institution.)

Size Inheritance in Rabbits. By E. C. MacDowell, with a Prefatory Note and Appendix by W. E. Castle. Pp. 55. (Washington, D.C.: Carnegie Institution.)

The Daily March of Transpiration in a Desert Perennial. By E. B. Shreve. Pp. 64. (Washington, D.C.: Carnegie Institution.)

Guide to the Materials in London Archives for the History of the United States since 1783. By C. O. Paullin and Prof. F. L. Paxson. Pp. xi+642. (Washington, D.C.: Carnegie Institution.)

Tasmania. Department of Mines. Geological Survey. Bulletin No. 14. The Middlesex and Mount Claude Mining Field. By W. H. Twelvetrees. Pp. iv+131 and maps and sections. (Hobart: J. Vail.)

Lehrbuch der Physikalischen Chemie. By Dr. K. Jellinek. Vier Bände. Erster Band. Die Lehre von den aggregatzuständen. (I. Teil.) Pp. xxxvi+732. (Stuttgart: F. Enke.) 24 marks.

Bacon's Excelsior School Map of the United States. (London: G. W. Bacon and Co., Ltd.) 15*s*.

Geological Excursions round London. By G. MacDonald Davies. Pp. v+156. (London: T. Murby and Co.) 3*s*. 6*d*. net.

The Great Society: a Psychological analysis. By G. Wallas. Pp. xii+406. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Catalogue of Scientific Papers. Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. xiii., A–B. Pp. xcviii+951. (Cambridge University Press.) 2*l*. 10*s*. net.

Allgemeine Geologie, iii. By Prof. F. Frech. Dritte Auflage. Pp. iv+124. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Impurities of Agricultural Seed. By S. T. Parkinson and G. Smith. Pp. 105+xxxviii plates. (Ashford, Kent, and London: Headley Bros.) 3*s*. net.

The British Isles. By Dr. F. Mort. Pp. xi+231. (Cambridge University Press.) 3*s*.

The Ileo-Cæcal Valve. By Dr. A. H. Rutherford. Pp. vii+62+plates. (London: H. K. Lewis.) 6*s*. net.

Careers for our Sons. Edited by the Rev. G. H. Williams. New edition. Pp. xii+564. (London: A. and C. Black.) 5*s*. net.

Board of Agriculture and Fisheries. Annual Report of the Education Branch on the Distribution of Grants for Agricultural Education and Research in the Year 1913–14. Pp. viii+149. (London: H.M.S.O.; Wyman and Sons, Ltd.) 8½*d*.

Memoirs of the Geological Survey. England and Wales. Explanation of Sheet 112 and the Southern Part of Sheet 100. The Geology of the Northern Part of the Derbyshire Coalfield and Bordering Tracts. By Dr. W. Gibson and C. B. Weed. Pp. viii+186. (London: H.M.S.O.; T. Fisher Unwin.) 3*s*.

The Rubber Industry in Brazil and the Orient. By C. E. Akers. Pp. xv+320. (London: Methuen and Co., Ltd.) 6*s*. net.

Arithmetic. By H. Freeman. Pp. viii+231+xxxi. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

Statics. Part i. By R. C. Fawdry. Pp. vii+165. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

Modernism and Traditional Christianity. By Rev. Canon E. McClure. Pp. 147–226. (London: S.P.C.K.) 6*d*. net.

A Treatise on Differential Equations. By Prof. A. R. Forsyth. Fourth edition. Pp. xviii+584. (London: Macmillan and Co., Ltd.) 14*s*. net.

Dialogues concerning Two New Sciences. By Galileo Galilei. Translated by H. Crew and A. de Salvio. Pp. xxi+300. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Song and Wings: a Posy of Bird Poems for Young and Old. By I. J. Postgate. Pp. xi+50 (London: A. Moring, Ltd.) 2*s*. 6*d*. net.

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year Ending June 30, 1913. Pp. 201. (Washington: Government Printing Office.)

Clay and Pottery Industries, being Vol. i. of the Collected Papers from the County Pottery Laboratory, Staffordshire. Edited by Dr. J. W. Mellor. Pp. xviii+411+plates iv. (London: C. Griffin and Co., Ltd.) 15*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JULY 2.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lithological Map of the British Isles: Alan G. Ogilvie.

FRIDAY, JULY 3.

GEOLOGISTS' ASSOCIATION, at 8.—A Geologist's Visit to Canada: Dr. J. W. Evans.

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THURSDAY, JULY 9, 1914.

HISTORY AND PHILOSOPHY OF MATHEMATICS.

(1) *Le Scienze Esatte Nell' Antica Grecia.* By Prof. G. Loria. Second edition. Pp. xxiv + 970. (Milan: Ulrico Hoepli, 1914.) Price 9.50 lire.

(2) *Ist es wahr dass* $2 \times 2 = 4$ *ist?* By Fred Bon. Vol. i. Pp. xxviii + 523. (Leipzig: Emmanuel Reinicke, 1913.)

(1) IN 1889 Prof. Gino Loria's notice was directed to a prize offered for the best history of mathematics. On turning his attention to this subject the author tells us that he became so interested in the study of the ancient Greek mathematicians that he decided to devote his attention to this instead of the more general subject. His previous writings have been published in the transactions of the academies of Turin and Modena, the latter between 1893 and 1902, and it is largely on these that the present volume is based.

The work treats mainly of geometry and arithmetic, but applied mathematics is dealt with in one of the five books, in so far as it relates to astronomy, geodesy, and spherical geometry. Prof. Loria divides the history of Greek geometry into three periods—the pre-Euclidean period of Pythagoras, Socrates, and Plato; the "golden" period of Euclid, Archimedes, Eratosthenes, and Apollonius, and a third period which is described as the "silver" or Græco-Roman age, of which Pappus of Alexandria forms one of the central figures.

In the section dealing with arithmetic and theory of numbers, great interest centres round the work of Diophantus, the discussion of which occupies eighty pages. The list of equations solved by this remarkable mathematician, stated in the notation of modern algebra, alone occupies twelve pages, and Prof. Loria has been throughout very careful in connecting these old problems with their present-day equivalents.

It is a great mistake that the Greek mathematicians in this book are only described by their modern Italian names. Such names as Erone, Tolomeo, Anassagora, Omero, will not convey much idea to foreign readers. The least the author should have done would have been to give the correct names in the index at the end, but this he has not done.

For a treatise of this character the small-sized pages of the Manueli Hoepli are a serious disadvantage. A pocket-book, the letterpress pages of which are a little larger than a quarter-plate negative, but smaller than "post-card" size may be suitable enough as a medium of publication for such subjects as ferro-concrete buildings, diseases of pigs, poultry farming, acetylene, or even calculus for engineers. But for a subject so teeming with points of historical and mathematical facts to be condensed into these tiny pages, closely printed in small type, renders the book very difficult reading indeed. The strain involved in reading the letterpress greatly increases the difficulty of assimilating the subject-matter.

(2) The inquiring reader who wishes to ascertain the truth, or otherwise, of the statement that two and two make four will not find Bon's attempts to enlighten him on this matter cramped by want of space. When he has come to the end of these 520 octavo pages he will only have learnt what the author has to say regarding the nature and meaning of concept, judgment, and truth, and he will have seen that this is only the first volume of Bon's work. He certainly will not yet have arrived at any definite conclusions as to whether two and two really make four or five, for that matter. This volume is divided into three parts, dealing with the nature and meaning of a concept, a decision, and of truth, with the object of examining what these mean, and under what conditions it is possible to assert that a decision is true.

In the chapter on the definition of a concept, the author starts with the statement that concepts are words, and arrives at the following kind of definition.

By *concept* we understand a word which has a meaning for one or more individuals, or, by *concept* we understand a word which is understood by one or more individuals. This attempt to identify a concept with a *word* will certainly not meet with unanimous acceptance, even in spite of the detailed discussions, extending over more than 230 pages, which follow. It might surely be objected that a concept can exist independently of words, and that it is not the word itself, but its meaning, or something which is associated with the word, which constitutes the concept. Of course, the author has to examine what is understood by meaning, by understanding, by words, or by a definition, whether a concept is definable or not, and if so, how far this is possible; at the same time, it is evident from what has been said that the author's views will not meet with universal acceptance.

In the definition of a decision or judgment (Urteil) (p. 261) the author again uses language as the basis of his definition, regarding a decision as a sequence of words which has a meaning independent of the meanings of the separate words and is understood by one or more definite individuals.

Chapter xii. contains some interesting paradoxes, especially those dealing with infinity. One of these may be briefly cited (pp. 241–243). If we suppose that a straight line is bisected and each half again bisected, and so on, and if we imagine that a limit exists when the segments become indivisible, we obtain, according to the author, an impossible result when we apply the method to the repeated bisection of a side and the diagonal of a square. Here, again, the present reviewer does not consider that the author of this book has quite arrived at the right explanation. If a line is made up of indivisible elements, this would seem to mean that it consists of a series of points, and unless the number of such points is an exact power of two the process of successive bisection will stop short long before the infinitesimal elements have been reached.

In the section dealing with "truth" the author classifies the various kinds of truth under different headings, such as that which is accepted as true, that which has been proved to be true by one or more experimental tests, that which has never been shown to be false, that which is in agreement with our laws of thought or with assumptions. He also devotes a whole chapter to the discussion of "half truths."

In expressing a doubt as to how far the author has succeeded in getting "nearer the truth," it must be admitted that the author has every right to attempt to place the remarks of the reviewer in one of his following categories: "The decision is true," "The decision is not true," "The decision is half true," "The decision is only true under certain conditions." But an equal right is possessed by any student of philosophy who will read the book, and it will probably be better if this test is applied to the book itself rather than to the very superficial and impressionistic description of a work of 523 pages which has been possible in the present limited space.

PRECURSORS OF CHRISTIANITY.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. Third edition. Part iv., Adonis, Attis, Osiris: Studies in the History of Oriental Religion. Third edition, revised and enlarged. Vol. i., pp. xvii+317. Vol. ii., pp. x+321. (London: Macmillan and Co., Ltd., 1914.) Price, 2 vols., 20*s.* net.

THE historical applications of Prof. Frazer's researches in early religion may be said to culminate in his study of the distinctive cults of ancient Syria, Phrygia, and Egypt. For through the agency of these three worships, spreading as they did through Greco-Roman Europe two thousand years ago, a continuity was established between the barbarism which was past and the civilisation which was coming. The link thus formed was, not to put too fine a point upon it, the Christian religion. Prof. Frazer regards the founder of Christianity as a historical personage, like Buddha, and both religions, so similar in their ideals, as ethical revolutions, aiming at a higher life than was possible for the majority of mankind.

"Both systems were in their origin essentially ethical reforms, born of the generous ardour, the lofty aspirations, the tender compassion of their noble Founders, two of those beautiful spirits who appear at rare intervals on earth, like beings come from a better world to support and guide our weak and erring nature. Both preached moral virtue as the means of accomplishing what they regarded as the supreme object of life, the eternal salvation of the individual soul, though by a curious antithesis the one sought that salvation in a blissful eternity, the other in a final release from suffering, in annihilation."

The author goes on to describe the process of accommodation—

"but the austere ideals of sanctity which they inculcated were two deeply opposed, not only to the frailties, but to the natural instincts of humanity ever to be carried out in practice by more than a small number of disciples. . . . If such faiths were to be nominally accepted by whole nations or even by the world, it was essential that they should first be modified or transformed so as to accord in some measure with the prejudices, the passions, the superstitions of the vulgar."

This is much in the style of Gibbon, and has a similar, though more sympathetic, spirit. The Protestantism of the early Christians was—

"exchanged for the supple policy, the easy tolerance, the comprehensive charity of shrewd ecclesiastics, who clearly perceived that if Christianity was to conquer the world, it could only do so by relaxing the too rigid principles of its Founder, by widening a little the narrow gate which leads to salvation."

One great lesson of these volumes is what may be called the permanent appeal of the elements of primitive superstition; another is the way in which Christianity has taken up those elements and transmuted them. It is the eternal compromise between the primitive and the modern in man.

"Yet it would be unfair," the author well adds, "to the generality of our kind to ascribe wholly to their intellectual and moral weakness the gradual divergence of Buddhism and Christianity from their primitive patterns. For it should never be forgotten that by their glorification of poverty and celibacy both these religions struck straight at the root, not merely of civil society, but of human existence. The blow was parried by the wisdom or the folly of the vast majority of mankind, who refused to purchase a chance of saving their souls with the certainty of extinguishing the species."

The substance of "Adonis, Attis, Osiris" is the story of how their faiths provided the machinery for Christianity. The moral of it is the historical appraisement of Occidental religion in modern culture which the student who runs may read.

A. E. CRAWLEY.

HABERLANDT'S PLANT ANATOMY.

Physiological Plant Anatomy. By Prof. G. Haberlandt. Translated from the fourth German edition by Montagu Drummond. Pp. xv + 777. (London: Macmillan and Co., Ltd., 1914.) Price 25*s*. net.

ANATOMY, whether of animals or of plants, is apt to prove dull reading if treated merely from the descriptive point of view. Such books we know; some have even been translated into English—it is hard to say why, for they are mere repositories of dry facts, and the individual dry bones, one would have thought, could well enough have been dug out of the original treatises whenever they were wanted. It is only when it is related to, or becomes part of, a larger and more philosophical scheme that anatomy becomes attractive to the ordinary scientifically minded reader who is not a specialist in the subject.

The great charm of Prof. Haberlandt's book has always lain rather in the circumstance that the anatomical facts had there been welded into a coherent theme of which the *leit motiv* was Function. It is true that speculation sometimes usurps the place of proof, and that teleology now and then breaks out, cloaked but thinly in the disguise of physiology. But it is a great book, and the fact that it has passed through four German editions, each an improvement on its predecessor, is a testimony to its intrinsic value.

Now that it is accessible to the English reader who happens to be unacquainted with German, its influence will be more widely felt amongst the students of botany in English-speaking countries. It deserves to be well received, for Mr. Drummond has discharged his task with ability, and by deciding on a somewhat free style of translation he has succeeded in producing a very readable volume which contains but little trace of its exotic origin.

In so far as we have tested the translation, we have lighted upon remarkably few errors of any importance; but perhaps it is not altogether superfluous to point out one instance in which a closer adherence to the text would have been of advantage. On p. 550, in discussing the relations existing between the assumed micellar structure and differential imbibition, the micellæ are said to "cohere with different intensities in different tangential planes." By translating the German word *richtungen* (directions) as *planes*, the meaning of the passage is obscured, and a situation already sufficiently complicated is rendered less intelligible.

It may be questioned whether any good purpose has been secured by placing all the notes at the end of the book, instead of grouping them with the chapters to which they severally belong, as they appear in the German edition. But this is, after all, a trifling matter, and at the most detracts but little from the excellent form in which a valuable and indeed classical work has been presented to the English reader.

J. B. F.

ELECTROTECHNICS.

(1) *Switchgear and the Control of Electric Light and Power Circuits.* By A. G. Collis. Pp. 85. (London: Constable and Co., Ltd., 1913.) Price 1*s*. net.

(2) *Elementary Theory of Alternate Current Working.* By Capt. G. L. Hall. Pp. vi + 195. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 3*s*. 6*d*. net.

(3) *Electricity in Mining.* With plans and illustrations. Siemens Brothers Dynamo Works, Ltd. Pp. xiv + 201. (London: C. Griffin and Co., Ltd., 1913.) Price 10*s*. 6*d*. net.

(4) *Electric Circuit Theory and Calculations: a Practical Book for Engineers, Students, Contractors, and Wiremen.* By W. Perren Maycock. Pp. xiv + 355. (London and New York: Whittaker and Co., 1913.) Price 3*s*. 6*d*. net.

(1) IN the preface to this manual the reader is referred for further information to the author's larger work on the subject. The present book would have been more valuable had it been carefully prepared. Some of the diagrams of the connections are inaccurate, and it is very difficult to make out what they mean.

(2) This work can be well recommended to those who are seeking the elementary theory of the subject. It has been compiled with accuracy and care, and forms a good introduction to the larger works on the subject of alternate current working. The latest developments are dealt with, and the whole treated in a simple manner without the aid of advanced mathematics.

(3) The novelty attaching to this work lies in the fact that it is compiled by a firm of electrical engineers. It is not a mere catalogue or description of electrical apparatus, but goes further, and deals with the technical part of the subject. The illustrations are good, and the book is well produced.

(4) This is one of Mr. Maycock's many works on electrical subjects, and is intended to deal with the requirements of Grade I. and the final examinations in electric wiremen's work of the City and Guilds of London Institute. It is therefore essentially a book for beginners, and as such can be recommended. It contains a number of questions and their solutions.

OUR BOOKSHELF.

Careers for Our Sons. A Practical Handbook to the Professions and Commercial Life. Edited by the Rev. G. H. Williams. Pp. xii+564. Fourth edition. (London: A. and C. Black, 1914.) Price 5*s*. net.

THAT this book has reached a fourth edition since its first appearance ten years ago is an indication of its usefulness to parents and guardians. There are few more baffling tasks than to find a suitable opening for a boy whose school and college training are completed, but who has no clear idea of what he desires to do to secure a livelihood. To those who are face to face with the problem this complete and well-arranged compilation may be recommended confidently. Mr. Williams is an old schoolmaster who has supplemented his own wide experience by much valuable information gathered from a large number of experts.

Manks Antiquities. By P. M. C. Kermode and Prof. W. A. Herdman. Second edition. Pp. 150. (Liverpool: University Press, 1914.) Price 3*s*. net.

THE first edition of this book, which was out of print for some time, was reviewed at length in the issue of NATURE for June 14, 1906 (vol. lxxiv., p. 152). During the ten years since the original appearance of the work, the authors have explored several additional prehistoric sites, and a systematic survey of the antiquities of each parish has been undertaken by a committee of the Isle of Man Natural History and Antiquarian Society. From these and other sources much new material has been worked into the present edition of the book, which will prove of interest and service to the people of the island and their summer visitors

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject Index. Vol. iii., Physics. Part II., Electricity and Magnetism. Pp. xv+927+vii. (Cambridge: The University Press, 1914.) Price 15*s*. net.

IN the review of the first part of the third volume of the Royal Society's catalogue of scientific papers, which appeared in NATURE on May 22, 1913 (vol. xci., p. 289), the general plan and scope of the work were described. It will be sufficient to say of this part that it completes the subject index on physics, deals with electricity and magnetism under the registration numbers 4900 to 6850, and contains 23,300 entries. This makes in all 56,644 entries for the subject physics for the years 1800–1900 inclusive.

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.*]

Active Nitrogen.

IN view of the apparently inexplicable contradiction between the results of Tiede and Domcke (*Ber.*, 1913, 46, 340 and 4095) and Baker and Strutt (*Ber.*, 1914, 47, 801 and 1049) on this subject, Tiede and Domcke offered to visit London with their apparatus, and it was arranged that each pair of experimenters should repeat their experiments in presence of the other. This was done, and as a result it was agreed that Tiede and Domcke were justified in their statement that the addition of a trace of oxygen to the azide nitrogen increased the intensity of the glow. With the form of discharge vessel and the electrical equipment used by them it was possible to diminish the afterglow considerably, and then to restore the brilliancy of the glow by the addition of an infinitesimal trace of oxygen, liberated by gentle heat from silver oxide. When the amount of oxygen added exceeded this very small quantity, the glow entirely disappeared, as all former experimenters have agreed.

On the other hand, employing the form of discharge vessel used by Baker and Strutt, which has not been described in detail, but is better designed for obtaining the glow, it was not found possible to observe any distinct diminution in the intensity of the glow, even when the vessel was washed out several times with nitrogen prepared by Tiede and Domcke with their own materials, as used in the previous experiment. It is always possible that if the experiment had been more prolonged a different result might have been obtained.

It appears, therefore, that a sample of nitrogen may be made to give the glow more easily if it is mixed with a trace of oxygen. On the other hand, the purest nitrogen with which we have worked in our joint experiments in London is capable of giving a brilliant glow under the experimental conditions used by Baker and Strutt.

It seems possible that the effect of the infinitesimal trace of oxygen is to alter the conditions of discharge so as to make it more suitable for the production of active nitrogen. Prof. Warburg's observations of the effect of traces of oxygen on the kathode fall in nitrogen tends to confirm this idea. Possibly other substances than oxygen may be found eventually to produce the same effect.

H. B. BAKER.
ERICH TIEDE.
R. J. STRUTT.
EMIL DOMCKE.

Imperial College of Science and Technology, London, July 2.

The Horns of the Okapi.

HITHERTO it has been considered that the horns of the male okapi, with the exception of the bare antler-like terminal caps, are permanently covered with hairy skin, like those of giraffes. The skin and skeleton of an old male okapi recently sent to Messrs. Gerrard, of Camden Town, by Dr. Christy, seem, however, to indicate that, extraordinary as it may appear, true horn-sheaths, like those of antelopes, are developed in at least some individuals. The skull, which, from the condition of the teeth, indicates an animal at least as old as the oldest of those figured in the respective memoirs of M. Fraipont and Sir Ray Lankester, carries the usual pair of conical bony horn-cores, which appear to have been devoid of terminal antler-like caps. In place of these being covered with hairy skin, the specimen, as mounted by Messrs. Gerrard, shows, however, that they were invested with (so far as I was able to determine) true horny sheaths, resembling candle-extinguishers, and recalling the terminal sheaths surmounting the hair-covered horn-cores of a prongbuck with newly developing horns figured by Dr. Sclater on p. 540 of the Proc. Zool. Soc. for 1880. Messrs. Gerrard were positive that the sheaths came with the skin, and as they appear to correspond in size with the bony cores, I see no reason to doubt the statement, more especially as the sheaths cannot apparently have pertained to any adult antelope.

Were it not for the fact that Dr. Christy is at present somewhere in the Belgian Congo, collecting on behalf of the Museum at Tervueren, I should have deferred making any statement on the subject until I had communicated with him. But as it may be months before I get a reply to a letter just dispatched (even if it ever reaches its destination), I have considered it advisable to put my observations on record, without, however, for the present, making them the basis of any deductions or speculations.

R. Lydekker.

Thorium Lead—An Unstable Product.

The work of Boltwood and Holmes some years ago on the occurrence of lead and uranium in minerals rendered it very improbable that the end product of thorium could be lead. From recent generalisations, however, in respect to radio-elements and the periodic law, it is to be expected that the end products of the radio-active elements should all be isotopic with lead. One method of attacking the problem is the determination of the atomic weight of lead extracted from uranium and thorium minerals. On the assumption that radium G and thorium E are stable, a knowledge of the composition of the mineral from which the lead has been extracted enables one to calculate the expected value for the atomic weight of the lead. Comparison of this value with that found experimentally gives a means of testing whether radium G and thorium E are stable or not.

Using this method, Soddy and Hyman (Trans. Chem. Soc., 1914, vol. cv., p. 1402) obtained a result for lead from a thorite rich in thorium and poor in uranium, which indicates that thorium E is stable. On the other hand, Richards and Lembert made a determination on lead extracted from thorianite, which points to the instability of thorium E (see Fajans, *Heidelberger Sitz. Ber. A.*, 1914, *Abh.* 11). Holmes (Nature, April 2, 1914) came to a similar conclusion by an examination of the ratio Pb/U_o for a series of analyses of radio-active minerals. If thorium E be stable, this ratio should be constant for minerals of the same geological age, but it should increase with the age of the mineral. Neither criterion was satisfied. In order to examine the question more fully, Holmes and the present writer examined the lead, uranium, and thorium contents of a series of radio-active minerals of Devonian age, from the same locality in Norway. The results of this investigation, shortly to be published, indicate very strongly that thorium E is unstable, and that it cannot therefore be regarded as the end product of thorium.

The present letter indicates how the above results have been applied by the writer to determine the half period value of thorium E, and the method has the advantage that it is quite independent of whether thorium lead (thorium E) is stable or not. A more detailed discussion of the question and its consequences will be published in the near future.

Amongst the minerals analysed by Holmes and the writer were several thorites and orangites, rich in thorium, and well adapted for an examination of the question of the stability of thorium E. These minerals being all of the same age, the total lead present may be regarded as the sum of the following three constituents: (1) Original lead (Pb_1), (2) uranium lead, (3) thorium lead. Further, whether uranium lead and thorium lead are stable or unstable, we can express the above statement as an equation thus:—

$$Pb = Pb_1 + \lambda.Th + \kappa.U.$$

Here Pb, U, and Th represent the content of the mineral in lead, uranium, and thorium respectively; λ is the amount of thorium E in equilibrium with 1 gram of thorium, and κ is the amount of uranium lead present in the mineral per gram of uranium. This last factor κ is constant for minerals of the same age, and varies in sympathy with the age of the mineral—this indicating that radium G is a stable product. The amount of original lead was assumed constant, since the minerals used were similar and from the same locality. Using the results of the analyses of three minerals, three equations are obtained by substitution in that above, and from these equations the values of λ, κ, and Pb_1 can be calculated. This calculation was performed with three different mineral combinations, and consistent results were obtained. The value of λ found was 4×10^{-5} gram. The value of κ found was 0·042, a result known to be correct from other considerations. Now it can readily be shown that the lead-producing power (calculated from the helium generation) of thorium is about 0·4 that of uranium. Whence, if thorium E is stable, the value of λ should be $0{\cdot}4 \times 0{\cdot}042 = 0{\cdot}017$. The low value ($4 \times 10^{-5}$) actually obtained seems to prove beyond question that thorium lead is unstable, and that it has a half period equal to 4×10^{-5} times that of thorium, or $4.10^{-5} \times 1{\cdot}5.10^{10} = 6.10^5$ years. It does not seem likely that thorium lead (thorium E) emits α rays, for these should have a range of about 3 cm., and would have been detected. If, on the other hand, it emits β rays, it is to be expected that bismuth would prove to be the end product of thorium. In any case, the systematic examination of radio-active minerals for bismuth seems highly desirable, for if it is the stable end product of thorium, the ratio Bi/Th will be found constant for minerals of the same geological age, and this ratio will vary in sympathy with the age of the mineral. Thus this ratio could be used for the determination of geological time just as that of lead to uranium has hitherto been used by Holmes ("The Age of the Earth," London; 1913) for the same purpose. If the bismuth isotope from thorium is unstable, the method indicated in this letter could be used to find its half period, and thus further information could be gathered as to the direction of the succeeding disintegration, *i.e.*, whether an α ray change brings the end product into Group III.B (Thallium) or a β ray change carries it still further to the Polonium Group (VI.B).

The one doubtful assumption in the present treatment is that in the minerals used for the calculation of λ, the percentage of original lead present is the same. This assumption is not without foundation, and in a forthcoming publication the writer will adduce evidence in support of the assumption in the case of the minerals used.

Robert W. Lawson.

Radium Institute, Vienna.

Radio-activity and Atomic Numbers.

LET Th_T, Ra_T, Ac_T be the periods of half-change of corresponding members of the thorium, radium, and actinium family respectively, M the atomic number, M(Pb) that of the lead-group, and c a constant ($\pm 4\cdot5$); then for all substances emitting α rays—

$$Th_T = \sqrt{Ra_T \cdot Ac_T / c^{M - M(Pb)}}$$

For analogous β-radiators $Ra_T \cdot Ac_T / Th^2_T$, though not unity for group B IV. is >1 for B III., and <1 for B V. (the only three groups in which comparable values are known).

The only exception here, as in all similar relations, is thorium-X (or actinium-X). For radiothorium, where a few months as well as two years are given for the period of half-change, the formula gives the first value. Of course, very accurate results cannot be expected from values like 2 min., 3 min., 0·002 sec., etc., but the differences are nowhere greater than what from this lack of precision must be expected.

	Periods of half-change:	Calculated	Experimental
Radiothorium	$\sqrt{365 \times 10^5 \times 19\cdot5/4\cdot5^8}$	d = 65 days	A few months
Thorium emanation...	$\sqrt{3\cdot86 \times 86400 \times 3\cdot9/4\cdot5^4}$	s = 56·4 sec.	53 sec.
Thorium A...	$\sqrt{180 \times 0\cdot002/4\cdot5^2}$	s = 0·134 sec.	0·14 sec
Thorium C^a_1	$\sqrt{45 \times 24 \times 0\cdot0333/4\cdot5}$	h = 2·83 hours	2·87 hours
Ionium...	$4\cdot5^8 \times 65^2/19\cdot5$	d = 10^5 years	10^5 years
Radium emanation ...	$4\cdot5^4 \times 53^2/3\cdot9$	s = 3·42 days	3·86 days
Radium A	$4\cdot5^2 \times 0\cdot14^2/0\cdot007$	s = 3·31 min.	3 min.
Radium C^a_1...	$4\cdot5 \times 2\cdot87^2/0\cdot0333$	h = 46·4 days	45 days
Radio-actinium... ...	$4\cdot5^8 \times 65^2/365 \times 10^5$	d = 19·5 days	19·5 days
Actinium emanation...	$4\cdot5^4 \times 53^2/3\cdot84 \times 86400$	s = 3·5 sec.	3·9 sec.
Actinium A...	$4\cdot5^2 \times 0\cdot14^2/180$	s = 0·0022 sec.	0·002 sec.
Actinium C_2	$4\cdot5^2 \times 10^{-22}/10^{-6}$	s = 2·10 ^{15} sec.	?
Actinium C^a_1	$4\cdot5 \times 2\cdot87^2/45 \times 24$	m = 2·03 min.	2 min.

A. VAN DEN BROEK.

Gorsel, Holland, June 26.

Seeing and Photographing Very Faintly Illuminated Objects.

THE question frequently arises, particularly among astronomers, whether it is possible to photograph objects too faintly illuminated to be seen. At the suggestion of Dr. Mees, the writer, assisted by Mr. Huse, has made some observations with measured illuminations giving comparative sensibilities of the human retina and an extra rapid photographic plate.

The source used was a sort of artificial moon consisting of a 10-candle Tungsten lamp in a metal box over the front of which were placed several layers of dense opal glass. The normal light flux from this surface measured equivalent to 8·6 metre candles. This intensity was further reduced by neutral filters transmitting 1/26 of the light. This source was placed at one end of a 20 ft. tube (our plate resolving power apparatus), at the other end of which a 6 inch F/5·3 telescope objective formed an image on the plate tested, or, with an ocular, on the retina.

The results obtained are tabulated below:—

Int. at source	On plate	On retina	Min. exp.	Vision
(1) 8·6 m.c.	0·24 m.c.	0·69 m.c.	16 sec.	Comportable
(2) 0·33	0·0092	0·026	7 min.	Distinct, unadapt.
(3) 0·0127	0·00035	0·00102	3 hr.	Distinct, after 3 min.
(4) 0·00049	0·000014	0·000039	over 50 hr.	Invisible, adapt.

In experiment (3) the plate illumination was just sufficient to produce a distinct image on a Seed 30 plate after an exposure of three hours, while the illumination on the retina as viewed was three times as great, the source being just easily visible after resting the eye about three minutes in total darkness. In other words, an image on the retina just visible after partial adaptation to darkness would just produce an image on a photographic plate after an exposure of *one hour*. The retina fully adapted to darkness is still a thousand times more sensitive than this.

P. G. NUTTING.

Rochester, N.Y., June.

June Meteors.

A PARAGRAPH referring to some brilliant meteors observed at Bristol on June 25 appeared in NATURE of July 2 (p. 464), and I am induced to send a few details of our June results, for they appear to me to exceed in importance and interest any obtained in any other month for a long period. There are a large number of double observations of the same objects, and I have been enabled to compute the real paths of fourteen, particulars of which are given in the subjoined table. They were all observed by Mr. S. A. Wilson and Mrs. Fiammetta Wilson (marked "W."), and some were recorded by Miss A. Grace Cook and some by myself. The very persevering and accurate observations by Mrs. Wilson and Miss Cook have been very successful in this branch of astronomy in the last few years.

Date 1914	G.M.T. h. m.	Mag.	Height at first, miles	Height at end, miles	Path miles	Velocity per second, miles	Radiant α °	Radiant δ °	Observers	Meteor appeared over
June 3	10 30	♀	51	48	160	25	281	−25	W. and others	The Wash to Durham
15	11 4½	4–1	60	52	26	19	260	−22	W. and W. F. D.	Alton to W. of Reading
,,	11 8½	2	87	62	68	35	279	−13	W. and W. F. D.	Wilts to Ross
,,	11 32	6–4	69	53	27	41	315	+21	W. and W. F. D.	Tunbridge Wells to Dorking
16	11 0	2–1	69	43	29	29	270	+50	W. and F. Denning	Selsey Bill (nearly vertical)
21	11 22	3–4	72	48	37	37	293	+10	W. and A. G. C.	Sea 34m. E. of Broadstairs
25	10 51½	>1	48	44	14	20	260	−24	W. and W. F. D.	12m. W. of Bristol to Usk [Harwich
,,	11 27½	♀	51	25	45	30	342	+39	W. and W. F. D.	12m. N.W. Chelmsford to 6m. N.W.
,,	11 46	5–4	68	48	39	25	258	+2	W. and W. F. D.	15m. W. Aldershot to Henley
,,	11 52½	1–♃	59	23	46	18	354	+77	W. and W. F. D.	10m. S.W. Luton to 8m. S.E. Reading
,,	11 57½	♃	67	67	52	52	350	−8	W. and W. F. D.	4m. N.W. Salisbury to Axbridge
26	11 11½	4–2	78	67	11	25	260	+70	W. and A. G. C.	S. of Bedford (nearly vertical)
,,	11 17¾	4–2	75	56	22	44	320	+61	W. and A. G. C.	Halstead to Bishops Stortford [Hants
29	11 25	1	64	53	19	26	320	+19	W. and W. F. D.	Eng. Chan. 32m. S. of Christchurch,

Now that the most attractive and prolific season for meteoric work is at hand I trust that some readers of NATURE may be inclined to watch the sky and record the apparent paths of such meteors as may appear. They are usually unduly plentiful between the middle of July and middle of August, and the great Perseid shower can be favourably traced during nearly the whole of the period named.

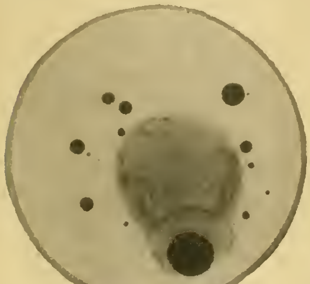
Any observations may be forwarded to the Rev. M. Davidson, director of the Meteoric Section of the British Astronomical Association, or to myself.

W. F. DENNING.

44 Egerton Road, Bristol, July 6.

Inorganic "Feeding."

AT the January meeting of the Physical Society, and also at the recent conversazione of the Royal Society, I showed an experiment in which one globule of liquid (dimethyl aniline), floating on the surface of water, captures and absorbs other floating globules (orthotoluidine), the movements resembling those of an amœba. I have now succeeded in photographing the process, and in the accompanying print the larger globule is seen in the act of engulfing the smaller and darker-coloured one. To secure contrast, the orthotoluidine was coloured with indigo.



An interesting extension of this experiment is provided by placing a small drop of quinoline on the surface after the absorption of the orthotoluidine is nearly complete. This drop approaches the large globule and makes contact, when it is violently repelled; it again approaches, and is then repelled with less force; and this alternate attraction and repulsion continues until the quinoline drop appears to be nibbling at the edge of the large globule, into which it is finally absorbed. The interesting feature of this process is that at each contact a mutual interchange of liquid occurs; and only when the quinoline has become mixed with a considerable quantity of the liquid composing the larger globule does absorption take place.

CHAS. R. DARLING.

City and Guilds Technical College,
Finsbury, E.C.

EXPERIMENTAL DEMONSTRATION OF AN AMPERE MOLECULAR CURRENT IN A NEARLY PERFECT CONDUCTOR.

IT has long been known that the electrical resistance of metals falls with a reduction of temperature in an approximately straight line law, indicating that, in the neighbourhood of absolute zero, there would be no resistance whatever. Prof. H. Kamerlingh Onnes, of Leyden, has carried experiments on this subject down to extremely low temperatures, and has found that it is at a point a few degrees above absolute zero that the resistance of certain pure metals practically vanishes. His later experiments illustrate the properties of these almost resistanceless bodies, or, as he terms them, "super-conductors," in a very striking way. Taking a closed coil of lead wire, he cooled it down by immersion in liquid helium to a temperature at which its resistance is of the order of 2×10^{-10} that at normal temperatures. He then induced a current in the coil, which, instead of ceasing with the E.M.F., was shown to persist with scarcely sensible diminution for as long a period as the coil could be kept cold. As there was practically no resistance, there was practically no dissipation of energy, and the system behaved like the imagined molecular currents of Ampère, and realised the conception of Maxwell as to a conductor without resistance.

The little coil in question was made of 1,000 turns of lead wire 1/70 mm. diameter, wound on a brass bobbin, and with its ends fused together. Its resistance at a normal temperature was 734 ohms, and it was calculated that the induced current would then only persist for 1/70,000th of a second after removal of the E.M.F. When cooled by liquid helium to 1·8° K. (abs.) the "relaxation time," according to previous determination of the resistance, should be a matter of days. The limiting value to which the current might be raised before the ordinary resistance suddenly makes its appearance had also been calculated, and found to be 0·8 amperes at 1·8° K. The coil was contained in a suitable vessel introduced between the poles of a large electromagnet, which was excited before the liquid helium was poured in. After the coil had been cooled down, the current was cut off from the magnet and a current thus induced. The unexcited magnet was then removed, and the persistence of a current of about 0·6 ampere in the lead coil was demonstrated by a magnetometer arrangement. During an hour no decrease in the magnetic moment produced could be observed, although the temperature had risen to 4·26° K. (that of helium boiling at atmospheric pressure). When the coil was lifted out of the helium the current ceased immediately as the temperature rose above 6° K., which is the "vanishing point" of the resistance of lead.

The experiment was repeated with the windings of the coil parallel to the field, to prove that the effect was not due to some magnetic property of the material of the wire or bobbin, which might only appear at these temperatures; and only a slight effect, such as might be accounted for by asymmetry of the coil, was observed. Further experiments were tried to measure the actual rate of falling off of the current due to the residual micro-resistance, and a falling off of less than 1 per cent. per hour (somewhat less than had been calculated) was all that could be observed. Other experiments finally disposed of all idea of direct magnetic action, and the actual presence of a continuing current was proved independently by attaching galvanometer leads to the points on the coil, and suddenly cutting the wire between them under the helium, when a swing of the galvanometer needle was observed, while the magnetometer immediately went to zero.

MEMORIAL STATUE OF CAPT. COOK.

ON Tuesday, July 7, Prince Arthur of Connaught unveiled a statue of Captain Cook, which stands on the Mall side of the Admiralty Arch, at the end of the Processional Road. The proposal to erect the statue was made in 1908 by Sir J. H. Carruthers, who pointed out that there was no memorial of Captain Cook in London. The matter was taken up by the British Empire League, and a general committee, under the presidency of the Rt. Hon. Herbert Samuel, M.P., was formed to promote the erection of a statue. The necessary funds were raised, and in 1911 Sir T. Brock, R.A., was commissioned to execute the memorial. One hundred and thirty-five years have elapsed since Cook met his death at the hands of savages in the Sandwich Islands, and it is remarkable that no monument to his memory should have been erected in the capital of the Empire. But if the statue is late it is undoubtedly adequate. The British Empire League deserves the gratitude of all citizens of the empire for its public spirit in raising so worthy a monument to one who extended the imperial bounds.

But James Cook (1728–1779) was more than this. He was a geographer of no mean standing, and his name will go down to posterity as one of the earliest of British discoverers. His three

Photo.] [*A. Burchell, Fulham.*
Statue of Capt. Cook.

voyages, all of them scientific, are well known by now. The first (1768–1770) was undertaken at the instance of the Admiralty, which was moved thereto by the Royal Society, for the purpose of prosecuting geographical researches in the Pacific Ocean. Several well-known men of science accompanied Cook on his voyage, on which, among other things, he struck the coasts of New Zealand and Australia. Round the former he sailed with complete success, examining it in detail; his name is associated with the channel which separates North from South Island (Cook's Strait). Of both New Zealand and Australia he took possession for Great Britain. The second voyage (1772–1775) had for its object the supposed southern continent in the Pacific, and Cook was able to prove finally that no such continent existed. It is worthy of note that on this second journey he reached latitude 71°49′ S. The third expedition was fitted out in 1776, and was principally to settle the question of the North West passage. It was on this voyage, in 1779, that Cook was killed.

Besides his contributions to geography, Cook was also an astronomer and mathematician. His skill as a geographical surveyor he had already shown as early as 1760, when he sounded and surveyed the St. Lawrence river and published a chart of the channel from Quebec to the sea. This activity he continued when, in 1763, he was appointed "Marine Surveyor of the Coast of Newfoundland and Labrador." It was shortly after this appointment that the Royal Society elected him one of its Fellows, on his giving an account of an eclipse of the sun which he had observed on the south coast of Newfoundland.

THE WILDS OF NEW ZEALAND.[1]

DR. J. M. BELL was for six years the director of the Geological Survey of New Zealand, and during his service there his duties and inclinations carried him into several of the most remote and least settled areas. A series of valuable memoirs on New Zealand geology has already testified to the enthusiasm and energy with which he threw himself into his work. In this volume he records his general reminiscences of his travels, and describes his numerous adventures by the flooded rivers, on the mountains, and in the bush, and narrates various incidents in the early history of the dominion. He was greatly impressed by the rich variety in both the topography and geology of New Zealand, and was delighted with its superb scenery, which is illustrated by a well-selected collection of excellent photographs by the Government Tourist Department, and by a series of artistically coloured sketches by his companion, Mr. C. H. Eastlake.

One of the first chapters describes the north-western province of the North Island, where Dr. Bell went to inspect the diggings for Kauri gum, which by 1912 had yielded produce to the value of more than 16,000,000*l*. In connection with his visit to the Thames goldfield, he summarises its mining history, and in connection with the volcanic fields of the North Island, describes his winter ascent of the volcano Ngauruhoe, a climb rendered difficult as the snow around the base was loose and soft, while that on the final slope was dangerously hard and steep. He also describes again the famous eruption of Tarawera, but the Black Geyser, Waimangu, it may be remarked, ceased to discharge daily six months earlier than the time mentioned by Dr. Bell. The most adventurous journey described in the volume was an attempt with Prof. Marshall, of Dunedin, to reach Mt. Arthur in Karamea, the north-

[1] "The Wilds of Maoriland." By Dr. J. M. Bell. Pp. xiii+253+plate London: Macmillan and Co., Ltd., 1914.) Price 15*s*.

western part of the South Island, when, owing to the roughness of the way and a wrong route, four days' provisions had to serve for seven, and the party might not have survived except for some chance birds that were killed by stones.

The last chapters describe Dr. Bell's journeys in the Southern Alps, and give a brief summary of the geography and climate of New Zealand. Most of the author's results have been stated in his geological papers, and as the present work is essentially popular he has excluded technical matter; but he writes of different areas with the intimate knowledge gained in the course of his surveys. The book gives an interesting account of the author's journeys, and is a useful record of the present conditions of some of the less-

Mount Balloon, near the track to Milford Sound. From "The Wilds of Maoriland."

known parts of New Zealand; it conveys a good impression of the magnificence and variety of New Zealand scenery, but indicates that the conditions of travel there are exceptionally rough and the accommodation often poor.

RECENT PROGRESS OF THE METRIC SYSTEM.[1]

WE have received a copy of a report on the progress of the metric system which was presented by Dr. Guillaume at the meeting of the fifth general conference on weights and measures held in Paris in October last. A previous report by Dr. Guillaume on the same subject was reviewed in these columns in 1908 (April 30). In the first part of the present work the author deals with the question of standards of measure and weight. As regards the use of vitreous quartz or silica for the construction of standards of length he points out that recent investigations tend to show that this material is unsuitable for the purpose, owing to inconstancy of length. A historical account is then given of the attempts made at the international bureau to find an appropriate material for the construction of standards of length for use in the laboratory, where the question of cost prohibits the employment of iridio-platinum. These efforts led to the important series of investigations with respect to the metrological properties of the alloys of nickel and steel, and to the discovery by Dr. Guillaume of the alloy of minimum expansion, now well known as "invar." The feeble expansion of invar would render this alloy an ideal material for standards of precision were it not for its tendency to instability. In spite of this drawback, however, its use for secondary standards deserves careful consideration in cases where an accuracy of one part in a million is sufficient.

Researches have also been made with the view of finding suitable alloys to replace iridio-platinum for the construction of secondary standards of weight. Various non-magnetic alloys of nickel were investigated. Of these constantan was found to be unsuitable, owing to its lack of durability, but "baros," formed by the addition of small quantities of chromium and manganese to commercial nickel, has proved to be more satisfactory. Tungsten, in virtue of its hardness, high density and durability, promises to be a very suitable material, especially as it seems likely that this metal will soon be obtainable at a relatively low price. Dr. Guillaume also discusses the results of recent researches with reference to the employment of wave-lengths of light in metrology, and points out that the gases krypton and neon both afford special advantages as regards interference measurements.

A section is devoted to legislation with respect to the metric system in various countries since the fourth general conference. During the past six years the system has been made obligatory in several countries, notably Denmark, Siam, the Belgian Congo, and certain of the republics of Central America. Dr. Guillaume considers that the difficulties standing in the way of the adoption of the system in Great Britain and the United States have been greatly exaggerated by its opponents. He urges that in the engineering trade, for example, the proposed innovation would not, as is often alleged, necessarily put out of use all machines the dimensions of which could not be expressed in convenient figures in terms of metric units; the first reform would be simply to give the metric equivalents of the quantities hitherto expressed in Imperial units; later on, when the machines were being replaced by new ones in the usual course, any slight modifications required might be introduced.

[1] "Les récents Progrès du Système métrique." By Ch. Ed. Guillaume. Pp. 118. (Paris: Gauthier-Villars, 1913.) Price 5 francs.

NOTES.

THE death of Mr. Joseph Chamberlain on July 2, at seventy-eight years of age, deprives the nation of a statesman who was not only a great political leader in the affairs of his country and Empire, but also gave notable assistance to the advancement of science and education. A few days ago the work done by him and his son, Mr. Austen Chamberlain, was commemorated by the unveiling of portraits of them in bronze relief in the branch hospital at the Royal Victoria and Albert Docks connected with the London School of Tropical Medicine; and the University of Birmingham, of which he was Chancellor, is a sufficient monument to what he did to promote national efficiency through education and research. Mr. Chamberlain began his public work in the city of Birmingham as an educational reformer and took an active part in the work of the first School Board there, while the University was practically founded by him. Speaking at a meeting of the council last week, the Vice-Chancellor, Mr. Gilbert Barling, said that Mr. Chamberlain guided the formation of the University and influenced its constitution in the most liberal and broad-minded manner. He obtained most of the funds for its building and equipment, and took the warmest interest in its welfare during the whole of his life after its foundation. The council of the University has expressed its high appreciation of Mr. Chamberlain's services in this direction by passing the following resolution:—"The council hears with profound sorrow of the death of Mr. Joseph Chamberlain, first Chancellor of the University, to whom the University owed its existence. His liberal and broad-minded views permeated its constitution, his judgment guided its policy from the commencement, and by his personal effort he secured munificent contributions to the funds for the buildings and equipment. The Chancellor's death will be felt by all members of the council and Senate, and indeed by the whole of the University, as a great personal loss." Few statesmen show such zeal for education and science as Mr. Chamberlain did; and we join with representatives of other national interests in mourning the loss of one who understood so well the business of government of a modern State. Mr. Chamberlain was admitted a fellow of the Royal Society in 1882, under the rule which permits the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the society."

BY the death of Sir Benjamin Stone, on July 2, at seventy-six years of age, there has passed from us one of the most enthusiastic and energetic of amateur photographers. Although photography was his recreation, he made a business of it in the sense of always working towards a definite end, namely, the getting of pictorial records of the details of the life of to-day. He did not initiate what is now well understood as "record work," but in 1897, when he was sixty years of age, he established the National Photographic Record Association, which did excellent work for twelve years, when it was disbanded so that the work might be carried on more effectively from local centres. During the whole life of the association Sir Benjamin Stone was its head, and we believe contributed personally a greater number than any other member of the nearly five thousand prints which are now deposited in the British Museum. These photographs represent interesting buildings of all kinds, remains of ancient buildings, manuscripts, portraits, ceremonies, customs, such as coronations, the distribution of Maundy money, fairs, and indeed anything that is likely to be of interest, especially when it has ceased to be.

CAPT. J. F. PARRY, R.N., assistant hydrographer, has been appointed to succeed Rear-Admiral Herbert E. P. Cust, C.B., as hydrographer of the Navy from August 16 next.

THE president and council of the Royal Society have awarded the Mackinnon studentship on the biological side to Mr. G. Matthai, of Emmanuel College, Cambridge, for a research on the comparative anatomy of the Madreporaria. The studentship on the physical side has not yet been awarded, and the date for receiving applications has been extended to September 21.

PROF. J. H. APPLETON has retired from the chair of chemistry at Brown University, Rhode Island. He graduated at that University in 1863, and has ever since been a member of its faculty, holding successively the status of assistant instructor, instructor, and professor. Dr. J. E. Bucher, at present assistant professor, is to succeed him in the headship of the department of chemistry.

THE death is reported of Dr. F. W. True, assistant secretary of the Smithsonian Institution, Washington. Born in 1858, Dr. True graduated at New York University in 1878, and in the same year entered the service of the U.S. Government, of the exhibits of which he was custodian at the Berlin Fisheries Exhibition of 1880. From 1883 to 1911 he held curatorships at the National Museum, of which he had previously been librarian. His publications included "A Review of the Family Delphinidæ," "The Whalebone Whale of the Western North Atlantic," and "An Account of the Beaked Whales of the Family Xiphiidæ."

THE Board of Agriculture and Fisheries is informed that on May 26 a porpoise was caught in a kettle net at Dungeness and transferred to Brighton Aquarium, where she arrived in good condition. She was noticed to be in an advanced stage of pregnancy when placed in a tank, and on the afternoon of May 31 gave birth to a young male, which was stillborn. The young was perfectly formed, and measured 2 ft. 2 in. in length, and weighed approximately 7 lb. Unfortunately the mother died on June 10.

IN the course of excavations to reach the base of the Red Crag at Thorington Hall, Wherstead, near Ipswich, Mr. Reid Moir has found the skeleton of a young female, about seventeen years of age, at a depth of 6 ft. from the surface of the ground. The Crag at this spot is capped by a hard, compact, loamy material, in all probability decalcified Boulder Clay, and the bones had been buried in a grave which was plainly visible in the loam. The body, of which nearly every bone has been recovered, had evidently been buried upon the back, and in the contracted position, the head being turned over the left shoulder and facing due west. On the right-hand side of the skeleton the fragments of an urn were found, which has now been rebuilt, and found to be an elaborately ornamented drinking vessel of the late Neolithic or early Bronze periods. No implements or ornaments of any sort were found with the remains. Both the human bones and the pottery are at present in the care of Prof. Keith at the Royal College of Surgeons, Lincoln's Inn Fields, W.C.

The Royal Academy of Belgium has issued its programme of prizes to be awarded during 1915. Among the subjects in mathematical and physical science for theses on which prizes from 35*l.* to 40*l.* are offered may be mentioned: the absorption of light in interstellar space; the viscosity of liquids and gases and the properties of fluids near the critical temperature; the organo-metallic compounds of one or more metals of the chromium group; infinitesimal geometry of curved surfaces; and conic systems in space. In the natural sciences, prizes of the same value are offered for researches in the following subjects: the significance of various inflections of the electrocardiogram; the spermatogenesis of burrowing hymenoptera; the subalpine flora of Belgium; a petrographical and geological description of some metamorphic region of the Ardennes; and descriptions of certain groups of Belgian minerals. The memoirs should be written in French, Flemish, or Latin, and be sent, post paid, to M. le Secrétaire Perpétuel, au Palais des Académies, à Bruxelles, before August 1, 1915. The bulletin from which the above particulars are taken also gives information concerning the various permanent prizes to be awarded during the years up to 1918.

The list of Civil List pensions granted during the year ended March 31 last includes the following grants for scientific services:—Mr. A. J. M. Bell, in recognition of his valuable contribution to geology and palæontology, 60*l.*; Mrs. Traquair, in consideration of the services to science of her husband, the late Dr. R. H. Traquair, F.R.S., and of her own artistic work, 50*l.*; Mrs. Gray, in recognition of the valuable contributions to the science of anthropology made by her husband, the late Mr. John Gray, 50*l.*; Mrs. Wallace, in consideration of the eminent services to science of her husband, the late Dr. Alfred Russel Wallace, O.M., F.R.S., 120*l.*; Mrs. Alcock, in recognition of the valuable contributions to the study of physiology made by her husband, the late Prof. N. H. Alcock, 50*l.*; Mrs. Ward, in recognition of the eminent services of her husband, the late Prof. Marshall Ward, F.R.S., to botanical science 40*l.*; Dr. Oliver Heaviside, F.R.S., in recognition of the importance of his researches in the theory of high-speed telegraphy and long-distance telephony, in addition to his existing pension, 100*l.*; Miss Hearder, in consideration of the contributions to electrical science and telegraphy of her late father, Dr. J. N. Hearder, 70*l.*; Miss Willoughby, in consideration of the services of her late father, Dr. E. F. Willoughby, in connection with questions of public health, 30*l.*

It is curious that whereas transatlantic telegraphy by submarine cables was accomplished many years before transatlantic wireless telegraphy, the reverse order of things appears more likely in the case of telephony. The great difficulty in long-distance cable telephony is the attenuation and distortion of the current waves in the cable by the effect of its capacity, and in an Atlantic cable it would—at any rate, with our present knowledge—be too expensive to compensate for by "loading" with artificial inductance. In wireless telephony, on the other hand, there is no such distortion depending on the distance. The difficulties are mainly concerned with finding a source of waves with a sufficiently high group frequency in the case of discontinuous waves, or of sufficient steadiness in the case of continuous waves, and constructing a microphone able to deal with the heavy currents necessary at the transmitting end. Successful experiments overcoming these difficulties to a greater or less extent, and in various ways, have been made by several investigators over moderate distances, and it would appear that it is now only a question of time to produce perfected apparatus of greater power, so that a longer range may be covered. Now that the large wireless station near Carnarvon is complete, Mr. Marconi hopes to succeed in telephoning to New York, and, according to a statement made by Mr. Godfrey Isaacs, chairman of the Marconi Company, before the Dominions Royal Commission last week, hopes to do so by the end of this year.

"The Plumage Bill: What it Means," is the title of a timely brochure by Mr. James Buckland—who may well be called the birds great protector—written with the object of influencing public opinion and stimulating the supporters of the Bill to further exertions in restoring those of its clauses which have been rendered almost nugatory by changes in Committee. In it we find a restatement of the evidence of creditable authorities and eye-witnesses—among them of A. H. Meyer, "himself a one-time plume hunter" and "thoroughly conversant with the methods employed in gathering" them—of the "horrors of the plume-trade," in Florida, Oregon, Australia, Lysan Island, New Guinea, India, and elsewhere, in which egret, grebe, pelican, albatross, kingfisher, and bird of paradise are immolated in millions to gratify the vanity of those women who *will* be feather-decorated whatever be the cruel methods by which their ornaments are obtained. Mr. Buckland emphasises the economic aspect of the question, and the enormous value of birds to the agriculturist in America, Jamaica, Russia, South Africa, and Australia, in which insect pests and rodents—all forming food of birds—are destructive almost beyond computation. Mr. Souef has ascertained by investigation that in a field attacked by a horde of grasshoppers in Australia, a flock of ibises, spoonbills, and cranes which hurried to the spot, were responsible for the destruction daily of 482,000,000 of the marauders. The devastation wrought by them would be infinitely greater if these birds should become exterminated. We commend this pamphlet to all interested in the wanton destruction of birds; and we trust that when the Bill comes up again before the House the "amendments" will be rejected and that the Bill in its original form may reach the statute-book before the close of this session.

IN *Man* for June Prof. J. Macmillan Brown announces the discovery of a new form of Pacific Ocean script in the little island of Oleai or Uleiai, one of the most westerly of the Caroline group. The chief, Egilimar, furnished a list of fifty-one characters, each of which represents a syllable. It has no connection with any other well-known alphabets, the only other script known in the groups or islands of the Pacific being that of the Easter Island tablets, which are ideographic. The Oleai syllabic script is a stage further than these in the development of an alphabet. The script is at present known only to five men on the islet: but it is probably a relic of a wide usage in the archipelago. A similar commercial script is that used in the island of Yap. This Oleai script is manifestly the product of long ages for the use of a highly organised community; in other words, it must have belonged to the ruling class of an empire of some extent that needed constant record of the facts of intercourse and organisation.

THE Commonwealth of Australia, in connection with the approaching visit of the British Association, has issued a "Federal Handbook," describing the continent in its scientific and historical aspects. This book contains in a compressed, but readable, form more information than is elsewhere accessible. Among the more important articles may be noted that on history by Prof. Ernest Scott, on physical and general geography by Mr. Griffith Taylor, and a very useful account of the culture and beliefs of the aborigines by Prof. Baldwin Spencer. The book is at present issued only in a limited edition, and it may be hoped that it will be re-issued to meet the wants of a wider public. The value of a new edition would be increased by a more adequate supply of maps, that of Australasia in particular being on such a small scale, with the names printed in such small type, as to be of little use for practical purposes.

A COLLECTION of fishes from the Rupununi River, British Guiana, is catalogued by Mr. H. W. Fowler in the April issue of the Proceedings of the Philadelphia Academy. A number of species are described as new, a few of which are referred to new genera or subgenera.

THE second part of the first volume of the new series of the Transactions of the Vale of Derwent Naturalists' Field Club contains one article by the president, Mr. R. S. Bagnall, on the woodlice of Northumberland and Durham, and a second on the centipedes and other myriapods of the Derwent Valley.

SPECIES-BUILDING by hybridisation and mutation is the title of an article contributed by Prof. J. H. Gerould to the June number of the *American Naturalist*. No evidence, it is urged, that species breed absolutely true on a large scale is at present forthcoming, and the assertion that hybrids between well-defined species are invariably infertile *inter se* is far from representing the true facts of the case.

MIMICRY and protective resemblance was the subject chosen by Mr. Rothschild for his presidential address at the anniversary meeting of the Hertfordshire Natural History Society, held at Watford on February 26. As reported in vol. xv., part 3, of the society's Transactions, the president considers natural selection to be the only adequate explanation of the phenomenon. "If a variable species happens to occur together with one or more species which are protected in some way, those individuals of the variable species more or less resembling the protected species have a greater chance of surviving and propagating than the individuals which are not similar to some protected form of animal. The result will be that in the course of generations the offspring will become more and more similar to the models and the dissimilar examples will gradually be weeded out."

STUDENTS of invertebrate histology will find much to interest them in Miss Sophie Krasińska's memoir, "Beiträge zur Histologie der Medusen," in a recent number of the *Zeitschrift für wissenschaftliche Zoologie* (Bd. 109, Heft 2). Zoologists are accustomed to look upon the histological structure of the jelly-fish as of a very simple character, and, although the discovery is not a new one, it is surprising to find them provided with striated muscle fibres which seem to resemble so closely those of arthropods and vertebrates. The memoir is beautifully illustrated, and shows how much we may still hope to add to our knowledge of the microscopic structure of invertebrate animals by the application of modern methods of investigation.

A NEW series of blue books dealing with Fishery Investigations is now being issued by the Board of Agriculture and Fisheries. Series I. relates to salmon and freshwater fisheries, and vol. i. is now before us. It contains two reports by Dr. A. T. Masterman, of which the first is on investigations upon the salmon with special reference to age determination by the study of scales. The material examined consisted of records of salmon captured in the Wye in the nettings made by the Wye Fisheries Association, including special experimental nettings made during the close season. The most important data deal with the year 1911, commencing in the month of April. The scales of a large number of fish were secured and were specially studied from the point of view of age determination. Dr. Masterman concludes that the majority of Wye smolts remain for two years in the river, but a small proportion remain three years. The scale may be used as a fairly accurate gauge of the age of individual fish up to and including the grilse stage, but is not available for estimation of the period of time spent in the river after the return of the fish. The author regards age estimates of spawned fish from the scales as being of very doubtful value. Dr. Masterman's second report deals with observations on the smelt (*Osmerus esperlanus*). The scales of the smelt are specially suitable for age determination on account of the clear and definite arrangement of the ridges upon them, and the study of these scales is of considerable value in connection with the general question of the trustworthiness of the method of age-determination by means of scales.

VOL. cxxiii. of the *Sitzungsberichte* of the Vienna Academy of Sciences contains a paper presented on March 26 by Dr. J. v. Hann on the daily range of meteorological elements at the Panama Canal, based on hourly or two-hourly observations made at several stations. The harmonic analysis of the data (pressure, temperature, and humidity) is preceded by tables of monthly and yearly means. The latter show that the highest mean temperature and lowest relative humidity occur in March and April, and the lowest temperature in November. From May to October the humidity is uniformly high, and especially so from January to April, while Colon (on the Atlantic coast) is much damper. Rainfall increases from the Pacific to the Atlantic shore, January to March being very dry. The wettest months on the Pacific slope are May, October, and November; on the Atlantic coast July and October are wettest. Without entering into detail here respecting the results of the laborious calculations entailed in computing the harmonic constituents, we may note that both the whole-day and half-day periods show that an increase of 10° C. in temperature corresponds to a decrease of about 36 per cent. in the relative humidity. Dr. v. Hann remarks that this relation between the two elements is exceedingly regular.

MESSRS. ISENTHAL AND CO. have produced an improved type of electrolytic rectifier. The older forms of the aluminium rectifier or "valve" for converting alternating into continuous current were never very popular; trouble was experienced due to heating of the electrolyte, and the arrangement of the four cells, usually of glass, necessary for rectifying both half-waves of the alternating current, was not always a convenient one. In the new design the electrodes, which are in the form of grids protected from action of the electrolyte at the surface level of the liquid, are placed in a solid seamless steel tank, instead of in four separate glass vessels. The trouble due to temperature rise appears to have been overcome, and the whole apparatus is in a compact and workmanlike form.

THE Board of Trade has now issued a report on the new sight tests used in the Mercantile Marine. This report covers the period of April 1 to December 31, 1913. An improved wool test in which the candidate has to match five colours, and a lantern test, were used. The cases of colour-blindness are divided into those definitely rejected by the local examiners and those referred for a special examination, the local examiner being doubtful. Of the 286 definitely rejected in the local examination 148 failed in both the lantern and the wool test, and 138 failed in the lantern test only; there was no failure with the wool test which passed the lantern test. Of the 286, 93 appealed, 26 being successful. Of 125 referred cases, 20 were referred on both the lantern and wools, 101 on the lantern only, three on the wools only, and one on form vision as well. Of this number there were thirty failures; three of these were referred on both the lantern and wool test, twenty-six on the lantern only, and one on form vision as well. Those referred on the wool test alone were passed.

IN the April number of *Le Radium*, which has just reached us, Dr. C. Ramsauer, of the Radiographic Institute of the University of Heidelberg, describes a simple method of determining the amounts of radium, thorium, and actinium present in materials, even when the amounts are very small. The method consists in heating the materials to 1150° C. for four minutes, so as to drive out the radio-active emanations accumulated in the material, condensing it on a cold surface, and then studying the decay of activity of the material condensed. By a comparison of the decay curve with the decay curves obtained in the same way from the three radio-active substances separately, he finds he can deduce the quantities of the three present in the material tested with an accuracy of about 20 per cent. A test of the Kreuznach waters by this method led to a result in agreement with that previously obtained by the more accurate method of Becker which, however, determines the radium content only.

THE June number of the Proceedings of the Physical Society of London contains several papers of exceptional interest. In the first instance, there is the Guthrie lecture by Prof. R. W. Wood, on his recent work on resonance spectra, which he hopes will do something towards unlocking the secret of molecular radiation. This lecture, which is the first given, is very suitably introduced by a historical note from Prof. G. C. Foster relating to Prof. Guthrie, to whom the Physical Society owes its foundation. A second paper, by Dr. J. G. Gray, describes a number of new gyrostatic devices for manœuvring and stabilising a variety of moving bodies from torpedoes to airships. This paper is well illustrated. Mr. W. R. Bower shows that the problem of the rainbow may be treated by geometrical methods with great advantage, and Mr. S. Butterworth describes a zero method of testing vibration galvanometers. In two papers on radioactive problems, Messrs. T. Barratt and A. B. Wood furnish grounds for the belief that thorium-C consists of two substances, one giving the α and the other the β radiation, and Messrs. H. P. Walmsley and W. Makower show that the path of an α particle projected along a photographic plate is visible on development, and may be used to study the scattering of the particles by matter.

A PAPER dealing with the design of floats for hydroaeroplanes has been issued from the recently reopened Langley Aerodynamical Laboratory, and relates to experiments carried out on models in the naval tank at Washington. The results confirm those obtained elsewhere, and show that the float requiring least power for leaving the water is one with a V-shaped bow. Such a bow sends up a remarkable sheet of water which must be turned down again by the shoulder of the float if the best results are to be obtained. All the experiments were carried out with floats having a single step, and it is stated that the step should be well ventilated; air was allowed access to the step through one or two passages from the upper surface of the float, but without the assistance of cowls to increase the air pressure, an assistance which has been found advantageous in the case of experiments made elsewhere. Reference is also made in the paper to the pitching moments which arise when a float having a single step is used, and it is pointed out that whilst getting up speed the air controls are ineffective at first, and to reduce the period of lack of effective control it is proposed to put the step near to the centre of gravity. Certain disadvantages of another kind are thereby introduced, and for various reasons the above position has not yet been accepted as the best by all designers of hydro-aeroplanes.

WE have received from Washington a "Classified List of Smithsonian Publications Available for Distribution, April 25, 1914," published by the Smithsonian Institution. The papers included in the list are distributed gratis, except as otherwise indicated. Applicants for the publications are asked to state the grounds for their requests, as the institution is able to supply papers only as an aid to the researches or studies in which applicants are especially interested.

THE Congress of Naval Architects at Newcastle during the present week is marked in *Engineering* for July 3 by a number of articles descriptive of Tyneside engineering and shipbuilding works. Among these is a description of the appliances used in testing turbo-dynamos at the Heaton works of Messrs. Parsons, the success of the Parsons turbine-driven electric machinery being largely a consequence of the experimental work carried out by aid of this installation, which now admits of extensive and accurate testing work being done. Provision is made for testing at full load for several hours continuously turbo-dynamos having an output of more than 3000 kw. There are three large water-tube boilers and one Lancashire boiler and a network of pipes arranged so that steam may be supplied to any of the numerous test-beds. A separately fired superheater is used, so that almost any desired degree of superheat can be obtained. There are two independent condensing plants. Two powerful Heenan and Froude water-brakes have been installed, with which geared turbines may be tested up to 3000 brake-horse-power.

THE eleventh volume of the Journal of the Institute of Metals has now been issued. The volume runs to 437 pages, and is divided into three sections. The first contains minutes of proceedings, and is concerned largely with the annual meeting held in London last March. The presidential address by Sir Henry J. Oram, K.C.B., is printed in full, and the papers read at the annual meeting are also included, together with reports from the institute's committees. The second section is made up of a valuable collection of abstracts of papers relating to the non-ferrous metals and the industries connected therewith. The third part contains the memorandum and articles of association and a list of members. The volume has been well edited by the secretary of the institute, Mr. G. S. Scott, and is published by the institute, Caxton House, Westminster, at the price of 21*s*. net.

OUR ASTRONOMICAL COLUMN.

A FAINT NEW COMET (1914*c*).—A Kiel telegram, dated July 1, announces the discovery by Neujmin of a new comet on June 29 at 13h. 35·3 Simeïs mean time. It is stated to be of magnitude 12, and its position is given as R.A. 18h. 5m. 24s., and declination 12° 55′ S.

A further telegram from Kiel, dated July 2, gives Dr. Graff's observation of this comet on July 1 at 11h. 56·4m. Bergedorf mean time. Its magnitude is given at 12·5, and its position, R.A. 18h. 3m. 17·5s., and declination 12° 26′ 44″ S. A supplement to the *Astronomische Nachrichten* (No. 4747) gives some further positions. Aitken and Tucker observed the object with the 36-in. refractor on July 1 at 12h. 13·1m. Mount Hamilton mean time, and gave the position R.A. 18h. 2m. 52·5s., and declination 12° 21′ 29″ S. Graff and Schorr on July 2, at 11h. 36·5 Bergedorf mean time, state the object to be of magnitude 12·5, and situated at R.A. 18h. 2m. 13·2s., and declination 12° 12′ 53″. The comet is at present situated in the constellation of Serpens, and is a little south of Eta.

OPPOSITION OF EROS (433) THIS YEAR.—While the opposition of Eros, which will occur on September 18 of the present year, is not a very favourable one as regards its distance from the earth, Prof. E. C. Pickering directs attention to the occasion for pursuing a photometric study (Harvard College Circular, No. 183). By the courtesy of Prof. Cohn, director of the Recheninstitut, Prof. Pickering publishes the ephemeris and other data concerning this object from June 30 to the end of the year, to assist those making observations. The author publishes the interesting statement regarding a reduction now in hand of a large series of observations made by the late Oliver C. Wendell, which has indicated a new fact in the photometry of asteroids. It appears that Eros in 1898 was more than a magnitude fainter than in 1900. Similar changes occurred in other asteroids, as was shown in the case of Juno (3) (Har. Ann., xlvi., 201). When all the corrections are applied for distances from the sun and earth, for phase, and for variation due to rotation, another large source of variation is still apparent the cause of which is difficult to explain. Prof. Pickering emphasises this as an additional reason why observations both of the relative and absolute magnitude of Eros should be made this year.

RECENT PUBLICATIONS OF THE ALLEGHENY OBSERVATORY.—Dr. Frank Schlesinger and Mr. Charles J. Hudson give the results of a preliminary investigation (vol. iii., No. 9) regarding the determination of star positions by means of a wide-angle camera. The object of the research was to find a method of charting stars which would overcome the difficulty of insufficient comparison stars; the employment of a wide-angle camera will permit of a larger area of the sky being photographed on one plate. So far as the investigation has gone, the doublet used is considered well adapted for cataloguing purposes, and it covers a field of 25 square degrees, as compared, for example, with the 4 square degrees in the case of the plates for the Astrographic Catalogue. In another number (vol. iii., No. 11) Dr. Schlesinger gives a description with two plates of a large screw-measuring engine designed for taking plates of all sizes up to 8 × 10 in., and adapted to the measurement of stellar and solar spectrograms, as well as ordinary celestial photographs. The engine seems to have given great satisfaction, both for its convenience and accuracy of performance. Nos. 10 and 12 of the same publication give the orbits of the variable stars 18 Aquilæ and

88*d* Tauri respectively, the individual authors being Mr. F. C. Jordan and Mr. Zaccheus Daniel.

THE VARIABLE SATELLITES OF JUPITER AND SATURN.—*Astronomische Nachrichten* (No. 4741) is composed almost wholly of a long communication by Dr. P. Guthnick on the variable satellites of Jupiter and Saturn, treated as planetary analogies of variables of the δ Cephei type. The photometric observations here discussed deal with the observations he has made since the end of the year 1904 at the Bothkamp, and later at the Berlin, Observatories. The satellites included the four old ones of Jupiter, and Enceladus, Tethys, Dione, Rhea, Titan, and Iapetus of Saturn, in all ten objects, measured with the Zöllner photometer on refractors of 6-, 9-, and 11-in. aperture. Dr. Guthnick accompanies his paper with thirty-five curves of nine satellites, and compares them with each other. Among the deductions he draws may be mentioned that the inner satellites of both systems, Jupiter I. and II., Tethys and Dione, exhibit a principal maximum about the time of easterly elongation; in fact, all the light curves are very similar in their chief features. The outer satellites of both systems, Jupiter IV., and especially Iapetus, show, on the other hand, a very pronounced maximum in the neighbourhood of the westerly elongation. The middle satellites, Jupiter III., Rhea, and Titan, belong partly to the first and partly to the second group, or, in other words, exhibit an uncertain type. Dr. Guthnick refers at some length to the observations and deductions of Auwers, Engelmann, Pickering, Searle, Upton, Wirtz, etc., and gives some interesting tables, including one displaying the mean brightnesses at opposition, values of the albedo, masses and densities of the satellites of Jupiter and Saturn.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THIS congress opened at the Imperial Institute on Tuesday, June 23, and sat daily, except on Saturday and Sunday, until Tuesday, June 30. The number of Governments and societies represented by delegates were forty-two and forty respectively, and the total number of members and delegates was about four hundred. In these respects and also as regards the number and quality of the papers read, the London Congress showed a very great advance on the previous congresses, held in Paris and Brussels.

Education and Research in Tropical Agriculture.

Perhaps the most interesting tendency exhibited by those who read papers and took part in the discussions was that of insisting on the necessity for a better organisation of education and research in tropical agriculture. This note was struck in Prof. Dunstan's presidential address, but it was particularly satisfactory to hear it not only from a man of science such as the president, but also at meetings afterwards from practical planters and manufacturers, and from men who have held high administrative posts in the tropical colonies. The necessity for higher education in tropical agriculture was felt so strongly, that at its concluding meeting the congress passed unanimously a resolution instructing the general committee of the congress to cooperate with the London committee, which is now promoting the establishment of a higher Agricultural College in the British tropics.

On the question of better provision for research in tropical agriculture, the congress contented itself with appointing a committee to collect precise information regarding the organisation, work, and cost of agricultural departments in the tropics, with a view to more definite recommendations being made at a future congress.

A British Institute of Tropical Agriculture.

Closely connected with these questions of education and research is that of providing a permanent organisation to promote and safeguard the interests of those engaged in the higher branches of tropical agricultural work, and the congress cordially endorsed the suggestion made in the president's address that a British Institute of Tropical Agriculture should be founded. At the concluding meeting a resolution instructing the general committee of the congress to take the action necessary to this end, was adopted unanimously.

Social and Economic Questions.

The social and economic problems which arise in the practice of tropical agriculture are even more difficult and complex than those with which everyone in this country is familiar in connection with the home agricultural industry. The Brussels Congress gave special attention to the question of the supply of native labour in the tropics, and the reports on this subject collected for that congress are now in the press. The London Congress discussed two problems of this kind, viz., "Agricultural Credit Banks and Cooperative Societies," and "Sanitation on Tropical Estates." Sir Horace Plunkett took the chair at the former discussion, and a very interesting paper was read by Sir James Douie, giving an account of his experience of the working of such banks and societies in India, and more particularly in the Panjab. This formed the basis of a discussion which terminated in the adoption of a resolution by the congress to collect information and prepare a report on the working of such banks and societies in tropical countries. A paper on tropical hygiene and plantation work in the Federated Malay States, by Dr. Sansom and Mr. F. D. Evans, formed the basis of the second discussion, at which Sir Ronald Ross presided. In this case also the congress decided to appoint a committee to collect information and prepare a report, on the preventive measures possible against ankylostomiasis, cholera, dysentery, malaria, smallpox, and other diseases prevalent amongst native labourers on tropical estates.

On the same morning the congress also discussed the relation of the Phytopathological Convention of Rome to tropical agriculture, on a paper read by Mr. A. G. L. Rogers, of the Board of Agriculture. A considerable number of entomologists and mycologists working in agricultural departments in the tropics were present, and some of them were of opinion that the convention was not altogether suitable for adoption in the tropics. The discussion on this subject was resumed at the concluding meeting of the congress on a motion by Mr. E. E. Green (late of Ceylon) and Dr. Gough, of the Egyptian Ministry of Agriculture, that the congress should appoint a committee to consider how far the proposals in question are applicable to tropical countries, and on the suggestion of M. Brenier, of Indo-China, a rider was added to this motion that the Government delegates present should communicate this resolution to their Governments as soon as possible.

An interesting discussion also took place on a motion by Sir James Wilson and Sir Sydney Olivier on the subject of the support of the International Institute of Agriculture at Rome by tropical countries, in which a large number of members took part. A resolution was finally adopted, by which the congress decided to ask the committee of the congress to consider the whole question of cooperation with the International Institute of Agriculture.

Technical Problems.

The tropical crops which chiefly claimed the attention of the congress were rubber and cotton, one day being devoted wholly to the former and one and a half days to the latter. A good deal of discussion took place with regard to the alleged variation in the properties and quality of plantation Para rubber. The discussion made it clear that at present each manufacturer seems to have set up for himself an empirical standard of quality for plantation rubber, and that it is very desirable that some generally accepted standard should be adopted. A number of papers on the cultivation of Ceara, Castilloa, and other rubber-yielding species in various countries were also read, and Messrs. Petch and Green contributed interesting and useful papers on the tapping of Hevea and on the insect pests of Hevea respectively.

A series of papers on cotton was read dealing with almost every phase of this important subject, such as the breeding of new cottons, the selection of cotton-seed, the technical qualities which manufacturers require in new cottons, the methods of investigating cottons, and so on. One of the most interesting contributions on cotton was that by Lord Kitchener describing the successful reclamation of a large area of salt land in the Egyptian delta and its utilisation for cotton growing. Equally useful was the address delivered by Mr. Harcourt, Secretary of State for the Colonies, describing the work of the Imperial Institute, the British Cotton Growing Association, the Colonial Departments of Agriculture and other bodies, which under the direct control of the Colonial Office, or with its active sympathy and support, now further in every possible way the cultivation of cotton within the Empire.

The various subjects alluded to above occupy such an important place in every tropical country that a large proportion of the time of the congress was devoted to them, but time was also found for the discussion of a number of subjects which are of special importance to certain countries. Thus Prof. Carmody, of Trinidad, contributed a most interesting account of the experiments on cocoa cultivation and preparation now in progress in that island, and useful contributions on this subject were also made by Messrs. Johnson, Tudhope, van Hall, Booth and Knapp, and others.

Wheat is as yet scarcely regarded as a tropical crop, and Mr. A. E. Humphries's paper on the possibilities of wheat production in the tropics, no less than that of M. Baillaud on the wheats of Tunis and Algeria, was a revelation to many members of the congress of new and unsuspected areas suitable for wheat cultivation.

Herr Hupfeld's paper on the oil palm in the German colonies was another contribution of which special mention may be made, since it gave an authentic account of the actual operation of European machinery in West Africa in the extraction of palm oil, an innovation which is likely to revolutionise this immense industry, which has hitherto been conducted by natives using most primitive and wasteful methods.

In conclusion mention may be made of the hospitality extended to the members and delegates. H.M. Government gave a dinner to the foreign delegates and a reception for all the members and delegates on the evening of June 23. Both these functions took place at the Imperial Institute. On Saturday, June 27, a selected party of members and delegates was invited by the Duke of Bedford to visit the Woburn Experimental Farm, and by the Lawes Agricultural Trust to visit Rothamsted. The party exhibited great interest in the experiments in progress at both stations, which were explained to them by Mr. S. U. Pickering and Dr. Russell. A party also visited Kew on the same day on the invitation of Sir David Prain. During the week receptions were held by the Royal Geographical Society, the Royal Colonial Institute, and the Rubber Growers' Association, all of which were largely attended by members and delegates of the congress.

INTERNATIONAL COMMISSION FOR SCIENTIFIC RADIO-TELEGRAPHIC RESEARCHES.

THE idea of forming an International Commission for the scientific study of questions relating to wireless telegraphy arose from a conversation between Prof. Schmidt and Mr. Goldschmidt, at the International Time Conference in Paris in 1912. Representatives from various countries held a meeting in Brussels in October, 1913, at which a provisional committee was appointed and the general lines of the scheme for the organisation of the working were drawn up. It was decided to send out from the high-power station at Laeken, near Brussels, radio-telegraphic emissions at regular intervals, and that these emissions should be observed and measured by experimenters in Belgium and in other countries.

The commission held a sitting on April 6 at Brussels, under the presidency of Mr. Duddell, at which the commission was constituted definitely. The results already obtained were discussed and arrangements made for future experiments.

National committees, which formed part of the organisation of the International Commission, have been constituted in Belgium, France, and Great Britain. In Germany, many stations have agreed to receive the signals, and a more complete organisation will be formed soon. National committees are also in course of formation in Austria, Russia, Italy, Switzerland, etc.

At the last meeting it was decided to cooperate so far as possible with the work of the Committee for Radio-telegraphic Investigation of the British Association, and the scope of the work was set out.

A demonstration of the methods of emission and measurement in use at the high-power station at Laeken, Brussels, took place before the commission, and reports were read on changes that had been made and on future alterations. The improvements consisted mainly in the use of a new spark-gap having a great damping, and in increasing the extent of the antenna and of the amount of energy radiated.

Arguing from a comparison of the signals received from Brussels, Norddeich, and Paris, Prof. Wien pointed out that there appeared to be difficulties with the present spark circuit, and he expressed the wish that tests should be made with the continuous-wave system. The commission decided that a small high-frequency alternator should be acquired, considering that larger machines are not developed sufficiently yet to warrant the expense.

Reports were read on the photographic registration of signals and other subjects. The reports led to a discussion on the strength of the signals received at the various receiving stations, and the commission expressed the wish that the experimenters should send in, with the results of their experiments, the characteristics of their antenna, and that, whenever possible, they should employ photographic registration.

Mr. Duddell read a paper with regard to the methods and instruments to be employed at the different stations, and other communications were dealt with.

The officers of the commission, provisionally elected at the first meeting, were confirmed as follows:—President, Mr. Duddell; vice-president, Mr. Wien; general secretary, Mr. Goldschmidt; assistant secretary, Mr. R. Braillard.

THE RESEARCH DEFENCE SOCIETY.

THE annual general meeting of the Research Defence Society was held last week at the Royal Society of Medicine. About 160 persons were present, among them Sir William Osler, Sir John Tweedy, Sir David Ferrier, Prof. Cushny, Sir James Reid, Sir Charles Dalrymple, Sir John Brunner, Sir Hugh Bell, and Sir Francis Champneys. Expressions of regret for non-attendance were received from Mr. Waldorf Astor, Mr. Arthur Balfour, Lord Bath, the Dean of Canterbury, Lord Hugh Cecil, Lord Cromer, Sir Francis Darwin, Lord Faber, Lord Farrer, Bishop Frodsham, Mr. Walter Guinness, Lord Claud Hamilton, Sir John Prescott Hewett, Lord Kilmorey, Sir Norman Lockyer, Mr. Walter Long, Prof. Howard Marsh, Lord Northbrook, Sir Gilbert Parker, Sir Frederick Pollock, Sir William Ramsay, Lord Rayleigh, Sir Henry Roscoe, Lord Salisbury, Lord Sheffield, Sir Edgar Speyer, the Bishop of Stepney, Sir Frederick Treves, and Mr. Henry S. Wellcome. The chair was taken by the president, Lord Lamington.

Lord Knutsford, chairman of committee, presented the reports of the society. He referred to the Dogs Protection Bill, pointing out that such a Bill might have prevented the discovery of a cure for distemper; and he directed attention to the educational work of the society. "We are trying, trying, to make the truth understood."

The president then gave his address. After a reference to his predecessors in office, Lord Cromer and the late Sir David Gill, "Our society," he said, "is really a protecting guard for science, in its noblest form, against those who, whilst we can respect their feelings and desires, are led by their emotions rather than by their reason." We should look around, to see what other nations were doing. All nations were engaged in research involving experiments on animals, and that, in most instances, without any legal restriction. "That is a system of which I am sure this country would not approve. Our desire is to reduce human and animal suffering, and on no account to encourage any practice which could possibly tend to permit callousness or indifference to the pain suffered by others. I cannot help thinking that it is this idea which is at the back of the mind of anti-vivisectionists: it is the dislike of seeing human beings engaged in any undertaking involving pain, and the fear of its thereby hardening or debasing human character. It is not merely the fact of pain being inflicted upon the animal, but the fear of the reactive effect on the mind of the person who inflicts the pain. For instance, we should term a farmer, who chose a pet lamb to be killed, rather than one out of his flock, a man of brutal character; yet the pain to the animal would be alike in either case."

Speaking of pain in the animal world, "I may be wrong," he said, "but I am honestly convinced that it is not physical pain that causes the greatest amount of suffering to animals; it is when their instinct of self-preservation takes alarm that they suffer. Anyone who has seen wounded wild animals must have noticed how, when unalarmed, they appear indifferent to their wounds. It is only when their instinct of self-preservation is aroused, and they become aware of their disablement, that they seem to suffer. . . .

"I wish here to say, most emphatically, that the chief business of our society is not mere fighting. It is the quiet, steady educating of public opinion as to the true character and method of experiments on animals in this country, and the great advantages which these experiments give, not only to human life, but to the life and health of the higher domestic animals."

A vote of thanks was proposed by Sir Reginald Talbot, seconded by Dr. Sandwith. After the meeting, there was a demonstration with the kinematograph of living germs of cholera, typhoid, sleeping sickness, etc.

THE SYNTHETIC POWER OF PROTOPLASM.[1]

FROM the point of view of the biological chemist the phenomena of life are manifestations of interactions of colloidal and crystalline materials in a peculiarly organised solution; over and above this every form of protoplasm, existent in any organism, is stereochemically ordered in specific relationship to that organism, so that the products of synthesis have an impressed structure and manifest optical activity. It has been suggested by Prof. Armstrong that the protoplasmic complex may be regarded as built up of a series of associated templates which serve as patterns against which change takes place in the various directions necessary for the maintenance of vital processes. This view is based on the well-known relationship between an enzyme and its hydrolyte; the synthetic enzymes, it may be supposed, serve as patterns for the elaboration of complex materials of definite pattern from the simple units.

In speculating on the origin of organic life from inorganic material Prof. B. Moore has ignored this stereochemical aspect of the question. His use of the well-known synthesis of formaldehyde from carbon dioxide and water in presence of an inorganic catalyst—in his case a colloid—can lead only to optically inactive material, and there is no justification even for the mention of the term life until evidence of directed synthesis is adduced.

The stereochemical hypothesis enunciated has been advocated by Prof. Reichert, of Pennsylvania, in his researches on hæmoglobin, in which he showed that this substance is modified in specific relationship to genus and species. He now extends the hypothesis to the study of starch, expecting that the peculiarities of the protoplasm in different species of plants will occasion the formation of different types of starch. The variations in the starch granule with origin are, of course, well known, and they are of industrial importance. They are now shown to be absolutely diagnostic in relation to the plant and to constitute a strictly scientific basis for the classification of plants. In addition to recording the microscopic characters of the starches an attempt has been made on a large scale to characterise them chemically, and although these tests are admittedly crude and leave much to be desired, they do mark a great advance in the treatment of the subject.

It may be regarded as established that starches of different origin vary both visibly and in chemical properties; moreover, plants of closely allied species contain starches with similar properties, and it is logical that such variations must be attributed to the differences of protoplasmic influence under which the starch granules are formed. It must not be overlooked, however, that starch granules are made up of three kinds of substances, namely, the true

[1] "The Differentiation and Specificity of Starches in Relation to Genera, Species, etc." Stereochemistry Applied to Protoplasmic Processes and Products, and as a Strictly Scientific Basis for the Classification of Plants and Animals. By Prof. E. T. Reichert. In two parts. Pp. xvii+900+102 plates. (Washington, D.C.: Carnegie Institution of Washington, 1913.)

starch degradable to maltose, which forms the bulk of the granule, amylocellulose or amylopectin, and a small proportion of carbohydrate, possibly crystalline, soluble in cold water. It is probable that these are present in different proportions in the various starches, and so give rise to such differences as Reichert has observed.

Some valuable observations on the characters of hard and tender barleys, published H. C. A. Vine in the Journal of the Institute of Brewing, may be mentioned in this connection. A barley corn may contain starch granules of all sizes, the variation being due to the conditions under which it develops. Malnutrition of barley leads to a high ratio of small starch granules which are more resistant to enzyme action, to moisture, and to heat than the normal mature granules. Those granules which have the more favourable position in the enclosing cell are able to appropriate a large proportion of the nutriment supplied by the protoplasm, and so become normal large starch granules, each consisting of many layers containing much granulose, tender and readily acted upon.

Similar observations were made by the writer some years back when it was pointed out that there is considerable variation in the proportion of large to small granules in wheat starch. Those types of flour which are the best for certain purposes contain the greatest proportion of large granules, the property being quite characteristic.

Hence it would seem that, over and above species variation, differences due to environment and nurture may appear in the starches, and it is possible that the further study of such a substance as starch may provide material for the solution of many vexed problems.

In addition to the detailed account of the tests applied to each starch, which are recorded also in the form of a curve which is shown to be characteristic for each individual, Prof. Reichert includes in his book a beautiful series of photomicrographs taken in ordinary and polarised light. These enhance very materially the value of the work, although they must have increased greatly the cost of publication. The author has further been at pains to summarise at some length previous work on starch, both on the chemical and on the botanical side. His account is a valuable one if only as showing how much uncertainty exists at present in the knowledge of starch and its transformations.

E. F. A.

TRANSPIRATION IN PLANTS.

TWO paper by Sir Francis Darwin (Proceedings of the Royal Society, B, vol. lxxxvii.) mark an important advance in the study of the process of transpiration in plants. Hitherto, although transpiration is perhaps more directly under the rule of external physical conditions than any other physiological function of plants, there has been no complete experimental demonstration of the relation between the loss of water-vapour from leaves and the relative humidity of the air or of the effect on transpiration of variation in the illumination to which the leaf is subjected. These lacunæ are due to the fact that transpiration depends largely on the opening and closing of the stomata, the aperture of which varies in area with varying external conditions. To eliminate from the problem the varying stomatal aperture, the author blocks the stomata by smearing the leaf with cocoa-fat or vaseline, and then makes incisions which place the intercellular spaces in communication with the atmosphere; by measuring the thickness of the leaf and making incisions of a certain total length, the area thus exposed is made to correspond with the area of the stomatal apertures under ordinary conditions. By using this ingenious method, the author finds that the line joining the abscissæ representing the transpiration for different degrees of atmospheric humidity is practically straight, but that the transpiration begins at about 5 per cent. above saturation, and from calculation of the vapour pressures at saturation and this degree of supersaturation, it appears that the internal temperature of the leaf which can distil off vapour in saturated air is about 1° C. above that of the air, this increased temperature being attributable to respiration.

The second paper gives the results obtained by applying this method to the investigation of the effect of light on transpiration. In April the transpiration of ivy was the same in diffused daylight and in darkness, while a month later the transpiration in light was double that in darkness, but the average ratio for transpiration in light and darkness was 135 : 100, though between May 14 and June 16 the laurel gave an average 150 : 100. The cause of the increased reaction to illumination in early summer as compared with spring is not completely explained, the author having no evidence as to whether the increased permeability of the leaves to water is a periodic effect, or connected with the age of the leaf, or with the brightness of the summer sky, as compared with illumination earlier in the year

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held in Philadelphia on April 23–25 inclusive, when numerous papers embodying the results of original researches were read. It is possible here to refer only to the more important and to those of wide scientific interest.

The president, Dr. William W. Keen, was in the chair at the opening meeting, and among the papers presented was one on the segregation of "unit characters" in the zygote of Œnothera with twin and triplet hybrids in the first generation, by Prof. G. F. Atkinson, Cornell University. The segregation of several distinct hybrid types in the first generation of a cross between two species is a rare phenomenon. In Prof. Atkinson's experimental studies, the two parents are *Œnothera nutans* and *Œ. pycnocarpa,* wild species of the evening primrose in the vicinity of Ithaca, N.Y. They differ by more than thirty easily recognisable contrast pairs of "unit characters," or, in terms of the "presence and absence" hypothesis, there are more than sixty "factors" or recognisable characters which meet in the fertilised egg of the cross between the two parents. These characters relate to the habit and colour of the adults, features of the rosettes, foliage, and inflorescence. When *pycnocarpa* is the mother, two distinct hybrid types are segregated in the first generation, and have been brought to maturity. These are "twin hybrids." When *nutans* is the mother, the same twin hybrids appear, and, in addition, a triplet which at present is in the rosette stage.

The analysis of the hybrids shows a distinct linking or association of certain characters. Examples of this linking of characters are as follows:—First, habit characters; secondly, colour characters; thirdly, petal characters; fourthly, broadness and toothedness of rosette leaves; fifthly, narrowness and cutness of rosette leaves; sixthly, crinkledness, convexity, and red-veinedness of rosette leaves; seventhly, plainness, furrowedness, and white-veinedness of rosette leaves.

The following hypotheses are considered:—(1) De

Vries's hypothesis of twin hybrids from mutating species; (ii) theory of a differential division in the zygote; and (iii) the reaction theory.

A paper on the vegetation of the Sargasso Sea was contributed by Prof. W. G. Farlow, of Harvard University. The Sargasso Sea is characterised by the scattered masses of gulf weed which float on the surface of the ocean in patches from 50 to 100 ft. in diameter. Some consider that the gulf weed, *Sargassum bacciferum*, is merely a mass of sterile branches of some species of Sargassum, which grows attached in the region of the West Indies, and fruits. Others believe that in its present floating form it is a distinct species which has lost the power of fruiting and increases only by offshoots. In recent years the species of Sargassum growing in different parts of the West Indies have been studied, and a comparison with the floating gulf weed shows that mixed with it are found fragments of at least two species known to grow in the West Indies. In only one instance has there been found mixed with the gulf weed a seaweed which must have come, not from the American coast, but from Africa or southern Europe. There is reason to think that the gulf weed is derived from some Sargassum growing in the West Indies, fragments of which are carried by the Gulf Stream to the Sargasso Sea.

On April 24 a paper on phase changes produced by high pressures was read by Mr. P. W. Bridgman, of Harvard University. Pressures as high as 30,000 or 40,000 kgm. per sq. cm. were employed. Examination of the melting of a number of liquids over a wide pressure range has shown that the theories hitherto proposed do not hold at high pressures. So far as can be judged the melting curve continues to rise indefinitely, so that a liquid may be frozen by the application of sufficient pressure, no matter how high the temperature. A number of results are also obtained for the reversible transition from one crystalline form to another. Several new solid forms have been obtained; of particular interest are the new forms of ice which are denser than water. In addition to these changes, which are completely reversible, one example has been found of an irreversible reaction produced by high pressure; yellow phosphorus may be changed by 12,000 kgm. and 200° to a modification in appearance like graphite, which is 15 per cent. more dense than the densest red phosphorus.

Prof. R. A. Millikan, of the University of Chicago, read a paper on some new tests of quantum theory and a direct determination of h. It has been known for twenty-five years that when light of sufficiently short wave-length falls upon a metal, it has the power of ejecting electrons from that metal. It has been known for seven years that the kinetic energy possessed by the electrons thus ejected is larger the higher the frequency of the light which ejects them. Whether or not the energy of ejection is directly proportionate to frequency has been a matter of some uncertainty. Prof. Millikan's work furnishes proof that there is exact proportionality between the energy of the ejected electrons and the frequency of the light which ejects them, and that the factor of proportionality between the energy of the ejected electrons and the frequency of the incident light is the same quantity as the fundamental constant which appears in Planck's theory of the discontinuous or explosive character of all radiant energy of the electromagnetic type. This constant is known as Planck's h, and its value is directly determined with an error which does not exceed 1 per cent.

Dr. Charles F. Brush, of Cleveland, discussed "A Kinetic Theory of Gravitation: (1) Gravitation is Due to Intrinsic Energy of the Æther; (2) Transmission of Gravitation cannot be Instantaneous." He employs illustrations to show that the energy acquired by falling bodies has some *external* source, and that it must be ætherial energy or energy of space; and he holds that the term "potential energy of position," as applied to a system of gravitating bodies, implies the energy-endowed æther as a necessary part of the system. As a corollary, he explains how bodies falling toward each other by reason of their mutual attraction, and thus *accelerating*—that is to say, absorbing energy from the æther—cannot rigidly obey Newton's law of inverse squares of distance. In the second division of the paper the premises from which Laplace drew his famous conclusion that gravitation is transmitted with infinite, or virtually infinite, velocity, are described, a dogma which, said Dr. Brush, "for more than a century has blocked the path of fruitful thought on the physics of gravitation." It is concluded that, even if the velocity of transmission is no greater than that of light, the moon's mean motion will be *retarded* a very few seconds of arc only, in a century; and the retardation will be correspondingly less if the velocity is greater than that of light. This retardation, of course, adds to the unexplained acceleration, if any, of the moon's motion; but the author further hopes that this retardation, plus the outstanding acceleration, will be explained by a particular deviation from Newton's law described.

Prof. W. Duane, of Harvard University, presented a contribution on highly radio-active solutions. The advantage in using these solutions in studying the effects produced on tissues is that after injection the radio-active substances come into intimate contact with the tissues, and thus the full power of the alpha rays is utilised. If a solution of radium itself is injected, the process is not only costly, but dangerous, on account of the long life of the radium. The solutions do not have these objections, for the radium is not wasted in producing the solutions, and the activity lasts for only a short time. If the injection is made subcutaneously, a large fraction of the activity remains in the neighbourhood of the point of injection, and the rest is carried off in the lymph and blood streams. The rapidity with which the activity gets into circulation is astonishing. A drop of blood taken from another part of the body only a few seconds after the injection is more radio-active than carnotite or pitchblende ores. It would seem that this might prove to be a delicate method of studying the flow of fluid through the tissues. On making tests by means of the gamma rays an hour or an hour and a half after the injection it was found that there was very little activity in the brain and lungs, but that there was a tendency for the substances to deposit out in the liver, spleen, and kidneys.

"The Relations of Isostasy to a Zone of Weakness—the Asthenosphere," was the subject of a paper by Prof. J. Barrell, of Yale University. The mass of every mountain tends to deflect the plumb-line slightly, so that the measured latitude and longitude of any locality will differ as it is determined by triangulation or by astronomic determination of the point in which the observed vertical pierces the celestial sphere. But Hayford has shown that the deflections of the vertical are actually only one-tenth of the deflections calculated as due to the terrestrial relief. This is a quantative test of the degree of isostasy. Dynamically it implies a state of flotation of the crust upon the inner earth analogous to the flotation of an iceberg in the ocean. Yet the earth as a whole is known to be as rigid as steel; the nature of earthquake vibrations transmitted through the earth shows it to be solid throughout and more incompressible and rigid at great depths than near the surface. How, then, shall the geodetic evidence pointing toward a general flotation of the crust near to equilibrium be reconciled with this other evidence of great rigidity and strength? It has been supposed that a mobile zone may explain the apparent contradiction, but the necessity of postulating such a zone becomes greater as the accumulated evidence of weakness on one hand, of strength on the other, diverges more and more. By means of a study of the areas of the surface loads and their degree of departure from isostatic equilibrium this zone is located far deeper than other estimates have placed it, the level of minimum strength being thought to lie as much as 150 to 200 miles deep. The maximum strength is probably at a depth of ten to twenty miles, and falls off rapidly below.

"The Geologic and Biologic Results of a Study of the Tertiary Floras of South-eastern North America" were presented by Prof. E. W. Berry, of Johns Hopkins University. The results of many years of study of the rich Tertiary floras of south-eastern North America were announced for the first time. Their botanical relationships and their bearing on the evolution of types and upon geographical distribution were summarised. The studies have afforded for the first time fossil floras of fixed stratigraphic position for comparison with the floras of the Rocky Mountain province on the border between the Cretaceous and Tertiary, the age of which has caused much controversy. They also afford means for correlation with the type of section of the Paris basin.

During the afternoon of April 24 a portrait of the late Dr. S. P. Langley, who was a former vice-president, was presented to the society by Dr. C. Adler on behalf of a number of members. On April 25 the following new members were elected as the result of balloting,—Mr. C. G. Abbot, Washington; Dr. J. W. Bright, Baltimore; Dr. B. M. Davis, Philadelphia; Dr. T. McCrae, Philadelphia; Dr. W. D. Matthew, New York; Dr. A. G. Mayer, Washington; Dr. S. J. Meltzer, New York; Dr. J. C. Merriam, Berkeley, Cal.; Prof. R. A. Millikan, Chicago; Prof. W. A. Noyes, Urbana, Ill.; Dr. Stewart Paton, Princeton; Dr. R. M. Pearce, jun., Philadelphia; Dr. P. C. Ricketts, Troy; Dr. Harold A. Wilson, F.R.S., Houston; Dr. F. E. Wright, Washington; Dr. Shibasaburo Kitasato, Tokyo; Prof. H. Kamerlingh Onnes, Leyden; and Dr. Vito Volterra, Rome.

At the concluding session of the meeting a medallion portrait of the late Sir Joseph D. Hooker was unveiled by Prof. W. G. Farlow, of Harvard University.

X-RAYS AND CRYSTALLINE STRUCTURE.[1]

TWO years have gone by since Dr. Laue made his surprising discovery of the interference effects accompanying the passage of X-rays through crystals. The pioneer experiment has opened the way for many others, and a very large amount of work, theoretical and practical, has now been done. As the preliminary exploration of the new country has proceeded our first estimate of its resources has grown continuously; we have learnt many things which help us to a better understanding of phenomena already familiar, and we have seen avenues of inquiry open out before us which as yet there has been little time to follow. The work is full of opportunities for exact quantitative measurement, where precision is sure to bring its due reward. There is enough work in sight to absorb the energies of many experimenters, and there is sure to be far more than we can see. When we consider the wideness of the new field, the quality and quantity of the work to be done in it, and the importance of the issues, we are scarcely guilty of over-statement if we say that Laue's experiment has led to the development of a new science.

The experiment itself—to put it very briefly—constitutes a proof that X-rays consist of extremely short æther waves. In order to appreciate the value of this demonstration, we must bear in mind the present conditions of our knowledge of the laws of radiation in general. Let us consider very shortly how the whole matter stood when the new work was begun.

When X-rays were first discovered eighteen years ago it was soon pointed out that they might consist of electromagnetic disturbance of the æther analogous to those supposed to constitute light. It was true that the new rays seemed to be incapable of reflection, refraction, diffraction and interference which were familiar optical phenomena. But it was pointed out by Schuster (NATURE, January 23, 1896) that these defects could be explained as natural consequences of an extremely small wave-length. The positive evidence consisted mainly in the knowledge that the impact of the electrons on the antikathode of the X-ray bulb ought to be the occasion of electromagnetic waves of some sort, and in the discovery by Barkla that the X-rays could be polarised, which last is a property also of light.

As experimental evidence accumulated, a number of results were found which the electromagnetic theory was unable to explain, at least in a direct and simple manner. They were mainly concerned with the transference of energy from place to place. In some way or other the swiftly moving electron of the X-ray bulb transfers its energy to the X-ray, and the X-ray in its turn communicates approximately the same quantity of energy to the electron which originates from matter lying in the track of the X-ray, and which is apparently the direct cause of all X-ray effects. Experiment seemed to indicate that X-ray energy travelled as a stream of separate entities or quanta, the energy of the quantum differing according to the quality of the X-ray. It looked at one time as if it might be the simplest plan to deny the identity in nature of X-rays and light, to describe the former as a corpuscular radiation, and the latter as a wave motion. Otherwise it seemed that the electromagnetic hypothesis would be torn to pieces in the effort to hold all the facts together.

But it appeared on a close examination of light phenomena also, though in much less obvious fashion, that the very same effects occurred which in X-rays were so difficult to explain from an orthodox point of view. In the end it became less difficult to deny the completeness of the orthodox theory, than the identity in nature of light and X-rays. Modern work on the distribution of energy in the spectrum, and the dependence of specific heat upon temperature have also led independently to the same point of view. It has been urged with great force by Planck, Einstein, and others that radiated energy is actually transferred in definite units or quanta, and not continuously: as if we had to conceive of atoms of energy as well as of atoms of matter. Let it be admitted at once that the quantum theory and the orthodox theory appear to stand in irreconcilable opposition. Each by itself correlates great series of facts; but they do not correlate the same series. In some way or other the greater theory must be found, of which each is a partial expression.

The new discovery does not solve our difficulty at once, but it does two very important things. In the first place, it shows that the X-rays and light are identical in nature; in fact, it removes every difference except in respect to wave-length. The question as to the exact place where the difficulty lies is decided for us; we are set the task of discovering how a continuous wave motion, in a continuous

[1] Discourse delivered at the Royal Institution on June 5 by Prof. W. H. Bragg, F.R.S.

medium can be reconciled with discontinuous transferences of radiation energy. Some solution there must be to this problem. The second important thing is that the new methods will surely help us on the way to find that solution. We can now examine X-rays as critically as we have been able to study light by means of the spectrometer. The wave-length of the X-ray has emerged as a measurable quantity. The complete range of electromagnetic radiations now lies before us. At one end are the long waves of wireless telegraphy, in the middle are, first, the waves of the infra-red detected by their heating effects, then the light waves and then the short waves of the ultra-violet. At the other end are the extremely short waves that belong to X-radiation. In the comparative study of the properties of radiation over this very wide range we must surely find the answer to the greatest question of modern physics.

So much for the general question. Let us now consider the procedure of the new investigations, and afterwards one or two applications to special lines of inquiry.

The experiment due to Laue and his collaborators Friedrich and Knipping has already been described in this lecture-room, and is now well known. A fine pencil of X-rays passes through a thin crystal slip and impresses itself on a photographic plate. Round the central spot are found a large number of other spots, arranged in a symmetrical fashion, their arrangment clearly depending on the crystal structure. Laue had anticipated some such effect as the result of diffraction by the atoms of the crystal. His mathematical analysis is too complicated to describe now, and indeed it is not in any circumstances easy to handle. It will be better to pass on at once to a very simple method of apprehending the effect which was put forward soon after the publication of Laue's first results. I must run the risk of seeming to be partial if I point out the importance of this advance, which was made by my son, W. L. Bragg. All the recent investigations of X-ray spectra and the examination of crystal structure and of molecular motions which have been carried out since then have been rendered possible by the easy grasp of the subject which resulted from the simpler conception.

Let us imagine that a succession of waves constituting X-radiation falls upon a plane containing atoms, and that each atom is the cause of a secondary wavelet. In a well-known manner, the secondary wavelets link themselves together and form a reflected wave. Just so a sound wave may be reflected by a row of palings, and very short sound waves by the fibres of a sheet of muslin.

Suppose a second plane of atoms to lie behind the first and to be parallel to it. The primary wave, weakened somewhat by passing through the first plane, is again partially reflected by the second. When the two reflected pencils join it will be of great importance whether they fit crest to crest and hollow to hollow, or whether they tend to destroy each other's effect. If more reflecting planes are supposed, the importance of a good fit becomes greater and greater. If the number is very large, then, as happens in many parallel cases in optics, the reflected waves practically annul each other unless the fit is perfect.

It is easily seen that the question of fit depends on how much distance a wave reflected at one plane loses in comparison with the wave which was reflected at the preceding plane; the fit will be perfect if the loss amounts to one, two, three, or more wave-lengths exactly. In its turn the distance lost depends on the spacing of the planes—that is to say, the distance from plane to plane—on the wave-length and on the angle at which the rays meet the set of planes.

The question is formally not a new one. Many years ago Lord Rayleigh discussed it in this room, illustrating his point by aid of a set of muslin sheets stretched on parallel frames. The short sound waves of a high-pitched bird-call were reflected from the set of frames and affected a sensitive flame; and he showed how the spacing of the planes must be carefully adjusted to the proper value in relation to the length of wave and the angle of incidence. Rayleigh used the illustration to explain the beautiful colours of chlorate of potash crystals. He ascribed them to the reflection of light by a series of parallel and regularly spaced twinning planes within the crystal, the distance between successive planes bearing roughly the same proportion to the length of the reflected wave of light as the distance between the muslin sheets to the length of the wave of sound.

Our present phenomenon is exactly the same thing on a minute scale; thousands of times smaller than in the case of light, and many millions of times smaller than in the case of sound.

By the kindness of Prof. R. W. Wood I am able to show you some fine examples of the chlorate of potash crystals. If white light is allowed to fall upon one of them, the whole of it is not reflected. Only that part is reflected which has a definite wave-length or something very near to it, and the reflected ray is therefore highly coloured. The wave-length is defined by the relation already referred to. If the angle of incidence is altered, the wave-length which can be reflected is altered, and so the colour changes.

It is not difficult to see the analogy between these cases and the reflection of X-rays by a crystal. Suppose, for example, that a pencil of homogeneous X-rays meets the cube face of such a crystal as rock-salt. The atoms of the crystal can be taken to be arranged in planes parallel to that face, and regularly spaced. If the rays meet the face at the proper angle, and only at the proper angle, there is a reflected pencil. It is to be remembered that the reflection is caused by the joint action of a series of planes, which in this case are parallel to the face; it is not a reflection by the face itself. The face need not even be cut truly; it may be unpolished or deliberately roughened. The reflection takes place in the body of the crystal and the condition of the surface is of little account.

The allotment of the atoms to a series of planes parallel to the surface is not, of course, the only one possible. For example, in the case of a cubic crystal, parallel planes containing all the atoms of the crystal may also be drawn perpendicular to a face diagonal of the cube, or to a cube diagonal, or in many other ways. We may cut the crystal so as to show a face parallel to any series and then place the crystal so that reflection occurs, but the angle of incidence will be different in each case since the spacings are different. It is not necessary to cut the crystal except for convenience. If wave-length, spacing, and angle between ray and plane are rightly adjusted to each other, reflection will take place independently of any arrangement of faces.

This is the "reflection" method of explaining the Laue photograph. W. L. Bragg showed in the first place that it was legitimate, and in the second that it was able to explain the positions of all the spots which Laue found upon his photographs. The different spots are simply reflections in the different series of planes which can be drawn through the atoms of the crystal. The simpler conception led at once to a simpler procedure. It led to the construction of the X-ray spectrometer, which resembles an ordinary spectrometer in general form, except that the grating or prism is replaced by a crystal and the telescope by an ionisation chamber and an electroscope. In use a fine pencil of X-rays is directed upon the crystal which is steadily turned until a reflection leaps out; and the angle of reflection is then measured. If we use different crystals or different faces of the same crystal, but keep the rays the same we can compare the geometrical spacings of the various sets of planes. If we use the same crystal always, but vary the source of X-rays we can analyse the latter, measuring the relative wave-lengths of the various constituents of the radiation.

We have thus acquired a double power :—

(1) We can compare the intervals of spacing of the atoms of a crystal or of different crystals, along various directions within the crystal; in this way we can arrive at the structure of the crystal.

(2) We can analyse the radiation of an X-ray bulb; in fact, we are in the same position as we should have been in respect to light if our only means of analysing light had been by the use of coloured glasses, and we had then been presented with a spectrometer, or some other means of measuring wave-length exactly.

We now come to a critical point. If we knew the exact spacings of the planes of some one crystal we could now by comparison find the spacings of all other crystals and measure the wave-lengths of all X-radiations. Or if we knew the exact value of some one wave-length we could find by comparison the values of all other wave-lengths, and determine the spacings of all crystals. But as yet we have no absolute value either of wave-length or of spacings.

The difficulty appears to have been overcome by W. L. Bragg's comparison of the reflection effects in the case of rock-salt or sodium chloride and sylvine or potassium chloride. These two crystals are known to be "isomorphous"; they must possess similar arrangements of atoms. Yet they display a striking difference both in the Laue photograph and on the spectrometer. The reflections from the various series of planes of the latter crystal show spacings consonant with an arrangement in the simplest cubical array. The smallest element of pattern is a cube at each corner of which is placed the same group, a single atom or molecule or group of atoms or molecules. In the case of rock salt, the indications are that the crystal possesses a structure intermediate between the very simple arrangement just described and one in which the smallest element is a cube having a similar group of atoms or molecules at every corner and at the middle point of each face. The arrangement is called by crystallographers the face-centred cube. The substitution of the sodium for the potassium atom must transform one arrangement into the other.

This can be done in the following way, if we accept various indications that atoms of equal weight are to be treated as equivalent. Imagine an elementary cube of the crystal pattern to have an atom of chlorine at every corner and in the middle of each face, and an atom of sodium or potassium as the case may be, at the middle point of each edge and at the centre of the cube. We have now an arrangement which fits the facts exactly. The weights of the potassium and chlorine atoms are so nearly the same as to be practically equivalent, and when they are considered to be so, the arrangement becomes the simple cube of sylvine. But when the lighter sodium replaces the potassium, as in rock-salt, the arrangement is on its way to be that of the face-centred cube, and would actually become so were the weight of the sodium atoms negligible in comparison with those of chlorine.

Of course, the same result would follow were two or three or any number of atoms of each sort to take the place of the single atom, provided the same increase was made in the number of the atoms of both sorts. We might even imagine two sorts of groups of chlorine and metal atoms, one containing a preponderance of the former, the other of the latter, but so that two groups one of each kind contained between them the same proportion of chlorine and metal as the crystal does. We must merely have two groups which differ in weight in the case of rock-salt and are approximately equal in weight in the case of sylvine. But it was best to take the simplest supposition at the outset; and now the evidence that the right arrangement has been chosen is growing as fresh crystals are measured. For it turns out that in all crystals so far investigated, the number of atoms at each point must always be the same. Why, then, should it be more than one? Or, in other words, if atoms are always found in groups of a certain number, ought not that group to be called the atom?

So soon as the structure of a crystal has been found we can at once find by simple arithmetic the scale on which it is built. For we know from other sources the weight of individual atoms, and we know the total weight of the atoms in a cubic centimetre of the crystal. In this way we find that the nearest distance between two atoms in rock-salt is $2 \cdot 81 \times 10^{-8}$ cm., which distance is also the spacing of the planes parallel to a cube face.

From a knowledge of this quantity the length of any X-ray wave can be calculated at once so soon as the angle of its reflection by the cube face has been measured. In other words, the spectrometer has now become a means of measuring the length of waves of any X-radiation and the actual spacings of the atoms of any crystal.

From this point the work branches out in several directions. It will not be possible to give more than one or two illustrations of the progress along each branch.

Let us first take up the most interesting and important question of the "characteristic" X-rays. It is known that every substance when bombarded by electrons of sufficiently high velocity emits X-rays of a quality characteristic of the substance. The interest of this comparison lies in the fact that it displays the most fundamental properties of the atom. The rays which each atom emits are characteristic of its very innermost structure. The physical conditions of the atoms of a substance and their chemical associations are largely matters of the exterior; but the X-rays come from the interior of the atom and give us information of an intimate kind. What we find is marked by all the simplicity we should expect to be associated with something so fundamental.

All the substances of atomic weight between about 30 and 120 give two strongly defined "lines"; that is to say, there are found among the general heterogeneous radiation two intense, almost homogeneous, sets of waves. For instance, rhodium gives two pencils of wave-lengths approximately equal to $0 \cdot 61 \times 10^{-8}$ cm. and $0 \cdot 54 \times 10^{-8}$ cm. respectively. More exactly the former of these is a close doublet having wave-lengths $0 \cdot 619 \times 10^{-8}$ and $0 \cdot 614 \times 10^{-8}$. The wave-lengths of palladium are nearly $0 \cdot 58 \times 10^{-8}$ and $0 \cdot 51 \times 10^{-8}$; nickel, $1 \cdot 66 \times 10^{-8}$ and $1 \cdot 50 \times 10^{-8}$. Lately Moseley has made a comparative study of the spectra of the great majority of the known elements, and has shown that the two-line spectrum is characteristic of all the substances the atomic weights of which range from that of aluminum, 27, to that of silver, 108. These X-rays constitute, there is no doubt whatever, the characteristic rays which Barkla long ago showed to be emitted by this series of substances.

Now comes a very interesting point. When Moseley sets the increasing atomic weights against the correspondingly decreasing wave-lengths, the changes do not run exactly parallel with each other. But if the wave-lengths are compared with a series of natural numbers everything runs smoothly. In fact, it is obvious that the steady decrease in the wave-length as we pass from atom to atom of the series in the periodic table implies that some fundamental element of atomic structure is altering by equal steps. There is excellent reason to believe that the change consists in successive additions of the unit electric charge to the nucleus of the atom. We are led to think of the magnitude of the nucleus of any element as being simply proportional to the number indicating the place of the element in the periodic table, hydrogen having a nuclear charge of one unit, helium two, and so on. The atomic weights of the successive elements do not increase in an orderly way; they mount by steps of about two, but not very regularly, and sometimes they seem absolutely to get into the wrong order. For example, nickel has an atomic weight of 58·7, whereas certain chemical properties, and, still more, its behaviour in experiments on radio-activity indicate that it should lie between cobalt (59) and copper (63·6). But the wave-lengths, which are now our means of comparison, diminish with absolute steadiness in the order cobalt, nickel, copper. Plainly, the atomic number is a more fundamental index of quality than the atomic weight.

It is very interesting to find, in the series arranged in this way, three, and only three, gaps which remain to be filled by elements yet undiscovered.

Let us now glance at another and most important side of the recent work, the determination of crystalline structure. We have already referred to the case of the rock-salt series, but we may look at it a little more closely in order to show the procedure of crystal analysis.

The reflection of a pencil of homogeneous rays by a set of crystalline planes occurs, as already said, at a series of angles regularly increasing, giving, as we say, spectra of the first, second, third orders, and so on. When the planes are all exactly alike, and equally spaced, the intensities of the spectra decrease rapidly as we proceed to higher orders, according to a law not yet fully explained. This is, for example, the case with the three most important sets of planes of sylvine, those perpendicular to the cube edge, the face diagonal and the cube diagonal respectively. An examination of the arrangement of the atoms in the simple cubical array of sylvine shows that for all these sets the planes are evenly spaced and similar to each other. It is to be remembered that the potassium atom and the chlorine atom are so nearly equal in weight that they may be considered effectively equal. In the case of rock-salt the same may be said of the first two sets of planes, but not of the third. The planes perpendicular to the cube diagonal are all equally spaced, but they are not all of equal effect. They contain alternately, chlorine atoms (atomic weight 35·5) only, and sodium atoms (atomic weight 23) only. The effect of this irregularity on the intensities of the spectra of different orders is to enhance the second, fourth, and so on in comparison with the first, third, and fifth. The analogous effect in the case of light is given by a grating in which the lines are alternately light and heavy. A grating specially ruled for us at the National Physical Laboratory shows this effect very well. This difference between rock-salt and sylvine and its explanation in this way constituted an important link in W. L. Bragg's argument as to their structure.

When, therefore, we are observing the reflections in the different faces of a crystal in order to obtain data for the determination of its structure, we have more than the values of the angles of reflection to help us; we have also variations of the relative intensities of the spectra. In the case just described we have an example of the effect produced by want of similarity between the planes, which are, however, uniformly spaced.

In the diamond, on the other hand, we have an example of an effect due to a peculiar arrangement of planes which are otherwise similar. The diamond crystallises in the form of a tetrahedron. When any of the four faces of such a figure are used to reflect X-rays, it is found that the second order spectrum is missing. The analogous optical effect can be obtained by ruling a grating so that, as compared with a regular grating of the usual kind, the first and second, fifth and sixth, ninth and tenth, alone are drawn. To put it another way, two are drawn, two left out, two drawn, two left out, and so on. The National Physical Laboratory has ruled a special grating of this kind also for us, and the effect is obvious. The corresponding inference in the case of the diamond is that the planes parallel to any tetrahedral face are spaced in the same way as the lines of the grating. Every plane is three times as far from its neighbour on one side as from its neighbour on the other. There is only one way to arrange the carbon atoms of the crystal so that this may be true. Every atom is at the centre of a regular tetrahedron composed of its four nearest neighbours, an arrangement best realised by the aid of a model. It is a beautifully simple and uniform arrangement, and it is no matter of surprise that the symmetry of the diamond is of so high an order. Perhaps we may see also in the perfect symmetry and consequent effectiveness of the forces which bind each atom to its place an explanation of the hardness of the crystal.

Here, then, we have an example of the way in which peculiarities of spacing can be detected. There are other crystals in which want of uniformity, both in the spacings and in the effective values of the planes, combine to give cases still more complicated. Of these are iron pyrites, calcite, quartz, and many others. It would take too long to explain in detail the method by which the structures of a large number of crystals have already been determined. Yet the work done so far is only a fragment of the whole, and it will take no doubt many years, even though our methods improve as we go on, before the structures of the most complicated crystals are satisfactorily determined.

On this side then we see the beginning of a new crystallography which, though it draws freely on the knowledge of the old, yet builds on a firmer foundation since it concerns itself with the actual arrangement of the atoms rather than the outward form of the crystal itself. We can compare with the internal arrangements we have now discovered the external forms which crystals assume in growth, and the modes in which they tend to come apart under the action of solvents and other agents By showing how atoms arrange and disarrange themselves under innumerable variations of circumstances we must gain knowledge of the nature and play of the forces that bind the atoms together.

There is yet a third direction in which inquiry may be made, though as yet we are only at the beginning of it. In the section just considered we have thought of the atoms as at rest. But they are actually in motion, and the position of an atom to which we have referred so frequently must be an average position about which it is in constant movement. Since the atoms are never exactly in their places, the precision of the joint action on which the reflection effect depends suffers materially. The effect is greater the higher the order of the spectrum. When the crystal under examination is contained within a suitable electric furnace and the atoms vibrate more violently through the rise of temperature, the intensities of all orders diminish, but those of higher order much more than those of lower. The effect was foreseen by the Dutch physicist Debije, and the amount of it was actually calculated by him on certain assumptions. I have found experimental results in general accord with his formula. In passing, it may be mentioned that as the crystal expands with rise of temperature the spacing between the planes increases and the angles of reflection diminish, an effect readily observed in practice.

This part of the work gives information respecting the movements of the atoms from their places, the preceding respecting their average positions. It is sure, like the other, to be of much assistance in the inquiry as to atomic and molecular forces, and as to the degree to which thermal energy is locked up in the atomic motions.

This brief sketch of the progress of the new science in certain directions is all that is possible in the short time of a single lecture; but it may serve to give some idea of its fascination and its possibilities.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The death of the Chancellor of the University, the Righ Hon. Joseph Chamberlain, cast a gloom over the annual Degree Congregation, and the festivities which had been arranged in connection therewith were all abandoned.

Mrs. Poynting has presented the scientific library of the late Prof. J. H. Poynting to the physics department of the University. The gift is a valuable one in itself and in its associations, and the spirit in which it is given is highly appreciated.

The opposition of the University to the proposal of the City Council to run a tram line past the front of Mason College has resulted in a compromise whereby the line is not to be used for the conveyance of passengers, and cars are only to be run along it during vacations or before 9.30 a.m. or after 6 p.m. on ordinary days, or on occasions of special pressure or emergency to be mutually agreed upon.

Dr. J. S. Anderson has been appointed assistant lecturer and demonstrator in physics for one year in succession to Dr. Fournier d'Albe. Mr. W. Hulse has been appointed demonstrator in mining in succession to Mr. Clubb. Mr. Gilbert Johnson has been appointed a member of the staff of the agricultural research section of the zoological department.

The degree of D.Sc. has been conferred on H. B. Keene and F. W. Aston, and the degree of M.D. on E. W. Assinder and O. M. Holden. The official degree of M.Sc. has been conferred on Prof. F. C. Lea and that of M.Com. on G. H. Morley, who has been secretary of Mason College and of the University since its foundation.

THE University of Liverpool has conferred on Mr. T. F. Wall, D.Sc., the degree of Doctor of Engineering.

PROF. D. T. GWYNNE-VAUGHAN, professor of botany in the Queen's University, Belfast, has been appointed to the chair of botany at University College, Reading, vacant by the resignation of Prof. F. W. Keeble, who has been appointed director of the experiment station and gardens of the Royal Horticultural Society at Wisley.

WE learn from *Science* that with the close of the present term at the Massachusetts Institute of Technonology, Prof. R. H. Richards will retire from the active work of teaching which he has followed for forty-six years. He has been made professor emeritus and receives the benefits of the Carnegie Foundation. Prof. Richards has been identified with the institute since its beginning. In 1871 he was appointed to the chair of mineralogy in the department that afterwards developed into that of mining, engineering, and metallurgy.

THE first Aitchison Memorial Scholarship is to be awarded next September. The scholarship was established by his friends and colleagues as a memorial of the late Mr. James Aitchison. Its value is 30*l.*, and it is tenable in the full-time day courses in technical optics at the Northampton Polytechnic Institute. Applications must be received by September 1 by Mr. Henry F. Purser, 35 Charles Street, Hatton Garden, London, E.C., from whom full particulars can be obtained.

IT is announced in the issue of *Science* for June 26 that at the celebration of the centenary of the foundation of the Yale University Medical School, large gifts were announced in addition to the 100,000*l.* from the General Education Board of the United States. These donations included a provisional gift of 100,000*l.* for the Anthony N. Brady foundation, and 120,000*l.* from donors not officially named. Our contemporary also states that by the will of the late Mr. James Campbell, the St. Louis University Medical School will receive his entire estate after the death of his heirs, who have a life interest in it. The present value of the estate is estimated to be from three to eight millions sterling. Also that by the will of the late Mr. Thomas W. Holmes, of Troy, Rensselaer Polytechnic Institute is bequeathed the sum of 10,000*l.* From the same source we learn that Miss Susan Minns has given 10,000*l.* to the department of botany of Wellesley College, in memory of Susan M. Hallowell, the former head of the department.

SOCIETIES AND ACADEMIES.

LONDON.

Linnean Society, June 18.—Prof. E. B. Poulton, president, in the chair.—R. D. **Laurie**: Reports on the marine biology of the Sudanese Red Sea.—On the Brachyura.—G. **Matthai**: A revision of the recent Colonial Astræidæ possessing distinct corallites.—C. F. M. **Swynnerton**: Short cuts to nectaries by blue tits. The author referred to his previous account of African ornithophilous flowers, read on March 5 last, and showing photographs of injured shoots of Ribes on the screen.—W. **West**: Ecological notes, chiefly cryptogamic. This paper was the outcome of a suggestion by Prof. Engler, that whilst abundance of observations existed of ecological facts regarding phanerogams, the cryptogams had been neglected. It was intended as the first of a series, which has been cut short by the death of the author. The observations extend over parts of Scotland, Wales, Ireland, and the Lake District.—R. J. **Tillyard**: Life-histories and descriptions of Australian Æschninæ, with a description of a new form of Telephebia by Herbert **Campion**.—Miss Olga G. M. **Payne**: The life-history and structure of *Telephorus lituratus*.—A. **Grouvelle**: Cucujidæ, Cryptophagidæ, avec une description de la larve et de la nymphe de *Protominia convexiuscula*, Grouvelle.—H. **Scott**: Mallophaga, Aphaniptera, and Diptera Puparia.

Challenger Society, June 24.—Dr. A. E. Shipley in the chair.—Commander Campbell **Hepworth**: The origin of the Gulf weed. Commander Hepworth initiated a discussion by referring to a form of Sargassum found in the central part of the Sargasso Sea. Seed-like bodies were stated to have been seen from which small leaves sprouted in various stages of growth up to 4 or 5 in. long. It was suggested that these might represent a mode of reproduction not hitherto recognised in Sargassum.—G. C. **Robson**: Lo Bianco's work on the periods of sexual activity in marine animals. The lists compiled by Lo Bianco from observations over a period of thirty years on the animals of the Gulf of Naples were analysed, and an attempt was made to discover causes for the differences of breeding period in various species, genera, and larger groups. It was concluded that while in certain cases it seemed possible to correlate these differences with the mode of life of the animals, in other cases the differences appeared to be non-adaptive.

PARIS.

Academy of Sciences, June 29.—M. P. Appell in the chair.—G. **Bigourdan**: The various classifications of nebulæ and star clusters and the abbreviations employed for describing these objects. A historical account of the systems of classification and the corresponding abbreviations due to J. Herschel, Schultz, Kobold and Wirtz, Wolf, S. I. Bailey, Stone, and Merecki. The author proposes a system partially based on these, and gives a list of the principal abbreviations which he suggests might be universally adopted.—J. **Meyeringh** and A. **Haller**: Dimethylallylacetophenone and its oxidation products. Careful oxidation with weak alkaline permanganate gave the glycol,

$$C_6H_5.CO.C(CH_3)_2CH_2.CH(OH).CH_2.OH,$$

or 2-benzoyl-2-methyl-4 : 5-pentanediol. The reactions of this glycol with benzoyl chloride and phenyl isocyanate have been studied, and the products are described.—André **Blondel**: Analysis of the induction reactions in alternators.—C. **Guichard**: Surfaces such that the osculating spheres to the lines of curvature of a series form an O or a 2I system.—Georges **Charpy**: The influence of time on the rapid deformations of metals. In testing metals by shock, the variation of the time of deformation was varied from 0·01 to 0·001 second, and this variation produced no practical differences in the work absorbed by the breaking.—H. **Parenty**: An experimental law for the flow of gases and steam through orifices.—F. W. **Dyson** was elected a correspondant for the section of astronomy, in the place of the late Sir David Gill.—A. **Buhl**: The normal curvature of closed contours.—R. J. **Backlund**: The zeros of the function $\zeta(s)$ of Riemann.—Theodor **Poeschl**: An evaluation of potentials.—Leonida **Tonelli**: A direct method for the calculus of variations.—Harald **Bohr**: The function $\zeta(s)$ of Riemann.—André **Léauté**: The problem of two electric lines branched in series.—A. **Schidlof** and A. **Karpowicz**: The evaporation of globules of mercury maintained in suspension in a gaseous medium. It was found in experiments designed to measure the elementary charge on fine mercury particles in suspension that the velocity of fall diminished continuously, an effect possibly due to evaporation. This phenomenon would vitiate the conclusions drawn by Ehrenhaft from his experiments.—Mlle. Paule **Collet**: The variations of resistance of crystals and residual electromotive forces.—J. **Minguin** and R. **Bloc**: The influence of solvents on the optical activity of the ortho- and allo-acid methyl camphorates and the neutral camphorate. The solvent exerts a very considerable influence on the optical activity. Thus the ortho-methyl camphorate in formic acid gave $\alpha=8{\cdot}16^\circ$, in cinnamene, $\alpha=13{\cdot}46^\circ$, numerous other organic solvents giving intermediate values.—M. **Leprince-Ringuet**: The inflammability of mixtures of methane and various gases.—F. **Ducelliez** and A. **Raynaud**: The bromination of cobalt and nickel in presence of ethyl ether. The compounds, $CoBr_2(C_4H_{10}O)$ and $NiBr_2(C_4H_{10}O)$, are produced. These are decomposed by heat and give the anhydrous bromides.—O. **Hönigschmid**: Revision of the atomic weight of uranium. Analyses of the bromide gave 238·175 as the mean value of fourteen determinations.—C. **Gaudefroy**: The dehydration of gypsum. The transformation of the hemihydrate into the soluble anhydride is reversible. This accounts for the different temperatures given by various observers as that at which the anhydrous calcium sulphate is produced the temperature depends on the hygrometric state of the air in the oven.—E. **Gley**: The function of the suprarenal capsules in the action of vaso-constrictive substances. Indirect vaso-constrictive substances.—J. **Chaine**: A fairly frequent error of interpretation in comparative anatomy.—A. **Vayssièrre** and G. **Quintaret**: A case of hermaphrodism in *Scyllium stellare*.—Maurice **Caullery**: The Siboglinideæ, a new type of invertebrates collected by the Siboga expedition.—MM. **Bonnefon** and **Lacoste**: Experimental researches on the grafting of the cornea.—H. **Busquet** and M. **Tiffeneau**: The rhythmic oscillations of the tonicity of the ventricles on the isolated rabbit's heart.—T. **Bézier**: The existence of a Carboniferous flora, possibly Westphalian, at Melesse (Ille-et-Vilaine).—R. **Tronquoy**: Some new data concerning the geology and petrography of the Congo.—Jacques **Deprat**: The Palæozoic strata and the Trias in the region of Hoa-Binh and of Cho-Bo (Tonkin).—J. **Giraud**: The sedimentary strata of the south and west of Madagascar.—Maurice **Lugeon**: The extent of the Morcles strata.—Jean **Chautard**: Contribution to the study of the origin of petroleum.—Pereira de **Sousa**: The effects in Portugal of the earthquake of November 1, 1755. The results of the study of a document by the Marquis de Pombal, recently discovered in the national archives of Lisbon.

CAPE TOWN.

Royal Society of South Africa, May 20.—The president in the chair.—T. **Muir**: Properties of Pfaffians and their analogues in determinants.—J. C. **Beattie**: The secular variation of the magnetic elements in South Africa during the period 1900–13. The annual changes in the magnetic declination vary from an average decrease of 1·5′ of westerly declination at Mauritius during 1900–9—a change which has turned into an increase of 1·4′ a year between 1907–9—to a decrease of 14′ a year in the neighbourhood of Durban; from the latter place the decrease becomes less as we go in a north-westerly direction, and attains a value of 5′ at Loanda; the decrease as we go west or south-west is also quite definite, though not so great, and at Cape Town has the value of 8′. It appears also that the absolute value of the decrease is increasing all over South Africa at the present time. A comparison of the results given in the paper with those of the American and British Admiralty declination charts for approximately the same epoch shows no continuity between the land values of the secular change and those over the sea, the high values over the land find no place over the sea except in the case of the result obtained from the *Gauss* and *Carnegie* observations. The greatest annual change of dip is found in the south-western part of the continent in the neighbourhood of Cape Town; it amounts to an increase of southerly dip of 8′ a year. The line of no change passes through Madagascar; east of that there is a decrease of southerly dip. The annual change in the horizontal intensity shows a decrease in absolute magnitude towards the north; over the greater part of the Union it has a value of from 80 γ to 100 γ yearly, and is a decrease.

BOOKS RECEIVED.

Historical Sketches of Old Charing. By Dr. J. Galloway. Pp. 82. (London: John Bale, Ltd.) 10*s.* 6*d.* net.

Le Musée d'Histoire Naturelle Moderne. Sa Mission, son Organisation, ses Droits. By G. Gilson. Pp. xii+256. (Bruxelles: Académie Royale.)

A First Course in Plant and Animal Biology. By W. S. Furneaux. Pp. viii+232. (London: University Tutorial Press, Ltd.) 2*s.*

Die Europaeischen Schlangen. By Dr. F. Steinheil. Sechstes Heft. Tafel 26–30. (Jena: G. Fischer.) 3 marks.

Handbuch der Pharmakognosie. By A. Tschirch. Lief. 35, 36, 37. (Leipzig: C. H. Tauchnitz.) 2 marks each Lief.

Berliner Botaniker in der Geschichte der Pflanzenphysiologie. By G. Haberlandt. Pp. 29. (Berlin: Gebrüder Borntraeger.) 1 mark.

Grundzüge der Weltpolitik in der Gegenwart. By J. J. Ruedorffer. Pp. xiii+252. (Stuttgart and Berlin: Deutsche Verlags-Anstalt.)

Principles of Metallurgy. By A. H. Hiorns. Second edition. Pp. xiv+389. (London: Macmillan and Co., Ltd.) 6*s.*

The Continents and their People. Africa. By J. F. and A. H. Chamberlain. Pp. vii+210. (London: Macmillan and Co., Ltd.) 3*s.*

Every Child's Series. How Man Conquered Nature. By M. J. Reynolds. Pp. v+249. (London: Macmillan and Co., Ltd.) 1*s.* 8*d.* net.

The Happy Golfer. By H. Leach. Pp. vii+414. (London: Macmillan and Co., Ltd.) 6*s.* net.

The School Algebra. By A. G. Cracknell. Pp. viii+568+lxxvii. (London: University Tutorial Press, Ltd.) 5*s.*

Pond Problems. By E. E. Unwin. Pp. xvi+119. (Cambridge University Press.) 2*s.* net.

Handbuch der Morphologie. Edited by A. Lang. Vierter Band. Arthropoda. Vierte Lief. Pp. 421–640. (Jena: G. Fischer.) 5 marks.

Roberts-Austen: a Record of his Work. Compiled and edited by S. W. Smith. Pp. x+382+xxiii plates. (London: C. Griffin and Co., Ltd.) 21*s.* net.

Historical Account of Charing Cross Hospital and Medical School. By Dr. W. Hunter. Pp. xxi+309+xl plates. (London: J. Murray.) 21*s.*

County Borough of Halifax. Bankfield Museum Notes. Second series. No. 4. Coptic Cloths. By L. E. Start. Pp. 37. (Halifax: King and Sons.) 2*s.* 6*d.*

Memoirs of the Geological Survey. England and Wales. The Water Supply of Nottinghamshire from Underground Sources. By G. W. Lamplugh and B. Smith. Pp. iv+174. (London: H. M. Stationery Office.) 5*s.*

Memoirs of the Geological Survey. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for 1913. Pp. iv+107. (London: H.M. Stationery Office.) 1*s.*

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THURSDAY, JULY 16, 1914.

LOCOMOTIVES AND RAILWAYS.

The Railways of the World. By Ernest Protheroe. Pp. xx+752+xvi plates. (London: George Routledge and Sons, Ltd., n.d.) Price 7*s.* 6*d.* net.

BOYS of to-day are indeed fortunate in their literature; books are available on most subjects, written to interest them—not merely fairy tales, but dealing with many themes in a scientific way and in language free from technical terms likely to worry the young mind.

The volume under notice is certainly one of the best of its kind, "Every Boy's Book of Railways and Steamships" by the same author was most interesting, but "The Railways of the World" is alluring; and as most boys love a locomotive and study railway working, they will indeed be delighted with the contents of this book and hasten to possess a copy.

To commence with, the usual account of the early locomotive and railway is dealt with: and, of course, Stephenson is given the lion's share of the credit. It is a pity that the earlier pioneers are being overlooked and forgotten. For instance, the Liverpool and Manchester and many other railways were projected and surveyed by William James, called by many "The Father of Railways," before Stephenson appeared on the scene. Again, the famous locomotive "The Rocket" was fitted with a multitubular boiler, the very soul of a locomotive, by the Stephenson's—this boiler being of William H. James's design, and used by Messrs. Losh and Stephenson, as recorded in an agreement dated September 1, 1821.

In a volume of this nature it is possible to deal with much interesting matter. In chapter iii. we find the locomotive past and present well treated. Stroudley's "Gladstone" awakens many reminiscences and we are only too pleased to find on page 421 that the author considers that "William Stroudley proved himself one of the cyclopean knights of locomotive engineering who have left their mark on British railway practice." With this we can cordially agree. Stroudley was the first locomotive engineer to pay attention to the details of locomotive design and his master hand can even now be recognised on many British railways.

Reference is made to the famous Caledonian engine No. 123, which did such remarkable work in "the race to the North" in 1888. This engine was built by Neilson and Co. of Glasgow, and not by the railway company as stated.

Chapter iv. is most interesting. Locomotives of to-day are described in a capable way, but as the space at our disposal is limited, detailed comment is impossible. We cannot, however, agree that "a built-up crank axle is screwed together," see page 102. The parts are heated and shrunk together, and sometimes have the additional security of a screwed plug in the joints.

It is interesting to note that our author refers to certain notable cases of heredity in locomotive engineering; many are, of course, interesting, but if the subject were pursued to the bitter end perhaps the records would not be so conclusive.

On page 358 the old fairy tale of building a six-coupled goods engine and tender in ten working hours is served up, but nothing is said as regards its cost. The inconvenience of specially preparing and arranging the work at the expense of disorganising the whole works for the time being is not referred to. If there was any economy the practice would be common, but, as a matter of fact, this is not the case.

The chapters dealing with Scottish railways are far too short. The locomotive history of the Caledonian railway is one of intense interest. The late Mr. Dugald Drummond of the London and South Western Railway became famous there, and more recently the magnificent locomotives, designed by Mr. J. F. McIntosh, have been the delight of locomotive connoisseurs; "The Dunalastair" being the first of his creation, the first with "the big boiler," a practice carefully followed ever since. "The Highland Chief," a fine sample of North British practice, and an excellent example of the big boiler policy is illustrated—facing page 482.

The volume concludes with interesting descriptions of Continental practice and that of other parts of the world, and the work has been well done. Nominally written for boys, the language used is sufficiently non-technical to be clear; on the other hand, the book will be found very interesting to the railwayman. The information is sound, the illustrations good, and the general appearance excellent.

N. J. L.

PARASITIC PROTOZOA.

Some Minute Animal Parasites, or Unseen Foes in the Animal World. By Drs. H. B. Fantham and Annie Porter. Pp. xi–319. (London: Methuen and Co., Ltd., 1914.) Price 5*s.* net.

THIS volume gives an account of the principal Protozoa which produce disease in man and in animals associated with man, *e.g.* domestic animals, game, bees, etc. As the book is intended to be of service to different classes of readers it has been written in a semi-popular style, and technical terms have been used sparingly. There is, however, no reason why the term "flea larvæ" should not have been employed instead of "tiny fleas" (p. 48), which is rather misleading. The introductory chapter deals with the structure and characters of the chief classes of Protozoa, and the ways by which the parasitic forms gain access to their hosts. The next chapter is on trypanosomes and their relation to tsetse-flies, and is followed by an account of the life cycles of the flagellate parasites Crithidia and Herpetomonas, which occur normally in the gut of fleas, lice, etc., and are liable to be confused with certain phases of blood-parasites. In the section on Spirochætes considerable attention is devoted to the vexed question of the shedding of granules. The authors have studied the granules in the large Spirochætes from molluscs and regard them as "spores," and consider "that the balance of evidence is somewhat in favour of the inclusion of the Spirochætes among the Protozoa."

In the account of malaria the interesting statement is made that within the last few years the authors have seen malarial parasites in the blood of children suffering from ague in the Fens, and have been able to secure specimens of *Anopheles maculipennis* "in whose stomachs cysts occurred and whose salivary glands teemed with sporozoites [of malaria]."

Eimeria (Coccidium), the organism of coccidiosis in birds, is fully described, and measures are indicated for preserving domestic poultry and hand-reared game-birds from the attacks of this parasite. The following chapters deal with Entamœba in man, Babesia (Piroplasma) in relation to "red water" in cattle, Theileria—the organism of East Coast fever in cattle in Africa, Leishmania in relation to kala azar, infantile kala azar and Oriental sore, microsporidiosis of bees (Isle of Wight bee-disease), various Protozoa parasitic in fish, the nasal parasite (Rhinosporidium) of man, and the parasite (Sarcocystis) of striped muscle. The two concluding chapters contain interesting accounts of the relations of parasitic Protozoa with their environment, their effects on their several hosts, and the economic importance of the study of Protozoa.

Throughout the work the authors have considered preventive measures, and have pointed out their prime importance in the fight against parasitic Protozoa.

The volume is illustrated by clearly-drawn text-figures; the magnifications of these figures might have been stated, as in the absence of such statement the general reader is apt to acquire an exaggerated idea of the size of, say, a Spirochæte.

The authors, who have themselves taken a considerable share in the investigation of several of the organisms described, have succeeded in giving a clear, accurate, and interesting account of the principal Protozoa which have been proved to exert so malign an influence on man and to limit his activities in ways innumerable.

GENERAL AND SPECIAL PHYSICS.

(1) *Sound. An Elementary Text-book for Schools and Colleges.* By Dr. J. W. Capstick. Pp. vii+296. (Cambridge University Press, 1913.) Price 4*s*. 6*d*.

(2) *Die Brownsche Bewegung und einige verwandte Erscheinungen.* By Dr. G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 3.50 marks.

(3) *Photo-Electricity. The Liberation of Electrons by Light.* By Dr. H. Stanley Allen. Pp. xi+221. (London: Longmans, Green and Co., 1913. Price 7*s*. 6*d*. net.

(4) *Course de Physique Générale. Leçons professées à la Faculté des Sciences de l'Université de Lille.* By H. Ollivier. Tome Premier. *Unités. Gravitation. Electricité et Magnétisme. Ions et Electrons. Symétries.* Pp. 716. (Paris: A. Hermann et Fils, 1913.) Price 18 francs.

(1) THIS text-book is one that many teachers will find suitable for recommending to students in their degree courses preparing for examination in sound. It is always gratifying to find the writer of a text-book on sound with some considerable knowledge of the fundaments of music. Dr. Capstick certainly does pay attention to this aspect of the subject and from this point of view there is nothing but praise to be said of it. In his first chapter he introduces the idea of intervals, and later he gives some very interesting chapters on consonance, musical instruments, and scales and temperaments.

In the parts that relate more especially to the physics of the subject, readers will not be quite so much at ease. There is a tendency for the theoretical treatment to lack clearness, and students reading for the first time will often be driven to consult a teacher. The same cannot be said of the descriptive parts of the subject, for these are treated in a very interesting way. In a book of this scope though, it is questionable whether it is a wise plan to follow Barton in consigning all account of acoustical measurements to one chapter. These would be much more in place if treated separately in connection with the theoretical treatment to which each applies. The descriptions in this chapter are undoubtedly good, and it is interesting to find there some account of intensity and audibility measurements and also of experiments to test the theories of vowel sounds.

The value of the book is increased greatly by an excellent collection of examples.

(2) This work on the Brownian movements is the outcome of a dissertation of the author, which was an account of a new method of attacking the theory of the subject. This method in itself seems to open a very promising field, for it can be applied to various branches of physics. Its application to Brownian movements consists in putting down the equation of motion of a particle in the form

$$m\, du/dt = -wu + F,$$

where w is given by Stokes's formula, $w = 6\pi\zeta a$, and F is a force which alters in direction in an irregular manner due to collisions with the molecules of the liquid. The mean velocity of a particle is calculated after n collisions, and it is shown how the influence of the initial motion diminishes in importance as n increases. Then the mean distance that a particle gets from its starting point in time t is calculated, and this comes to be exactly the same as that calculated by Einstein, whose formula has been experimentally verified.

An example of the application of this method is to calculate the energy of a magnetic needle at the centre of the coil of a tangent galvanometer due to a succession of small impulses of current in the coil. Some other applications are given, one of which has been worked out by Prof. H. A. Lorentz.

The work includes an account of the history of the development of our knowledge of the Brownian movements. The methods and results of the most important experimental researches on the subject are given and the theories of Einstein, Smoluchowski, and others discussed. The work of Millikan and others on the Brownian movements in gases is given a prominent place.

The new method of treating this interesting subject will be found instructive. Also from the point of view of a general treatment it can be recommended to all seeking a connected account of work on Brownian movements.

(3) Under the heading Photo-Electricity, is usually understood the emission of electricity from a metal surface when light falls on it, and the present volume is the first to be published which is devoted almost entirely to that subject. Dr. Allen, however, also includes in his book certain other subjects that are allied to the main one, such as fluorescence and phosphorescence, photo-chemical actions, and photography. Other relations between electricity and light such as the alteration of the resistance of selenium by light are not discussed. This is quite easy to understand, for the author had quite a large task without that.

Anyone who wishes to obtain a good account of the photo-electric effect ought to read this book. The subject is treated historically so far as possible, and a very clear account of the principal experimental work on the subject is given. The whole subject is so vast that the author is to be congratulated for having collected such a mass of results as he has done. There is a clear account of the methods for measuring the photo-electric current and the velocities of the electrons. The chief results for metals and solids and fluids generally are given. An exceedingly interesting chapter on the effect for gases comes about the middle of the book, and the importance of this in general physics is indicated, such as, for instance, the ionisation of the upper atmosphere.

Perhaps the most difficult task for the author was to give an account of the theories which have been advanced, and to decide on one as the most probable. In the present state of the subject Dr. Allen has taken the wisest course in deciding that the selective effect points to a resonance between the light and the electrons in the molecules, and indicating that the normal effect is most probably due to the same cause.

Readers will find the chapter on fluorescence and phosphorescence very interesting. A very clear account of Stark's and Lenard's views on these subjects are given. So also will practical photographers be interested in the chapter on photography. But the chief importance of the book is its value to the physicist who has not time to read through all the literature on photo-electricity and wishes to get a connected account of it.

(4) This is the first of three volumes which give in book-form the substance of a course of lectures on general physics at the University of Lille, 1911–13. The present volume is devoted chiefly to electricity and magnetism, which is treated under the headings Electrostatics, Magnetism, Current Electricity, and Electrons and Ions. In addition there are chapters on Gravitation and the Symmetry of Systems. Every part is treated so as to introduce the newest results. New work like the diffraction of X-rays by crystals, Barkla's work on X-rays, C. T. R. Wilson's photographs of the paths of single ions, and the magneton theory follow so logically each in its place, that one does not find it strange to see these newest developments in a general text-book. Many students will find the book of value because of the very clear account given of the most modern work in physics.

One new subject introduced is the symmetry of systems, which is really a summary of the work of P. Curie, and English readers will be thankful for having so easy a means of acquiring a knowledge of this important subject.

The book does not pretend to be an encyclopædia of physics, but it treats of the whole subject so as to bring students up to a standard when they can feel confident in taking up research on some definite subject. In other words, it meets the requirements of the standard of the Honours B.Sc. Examination. The whole book is clearly written, and teachers will have no hesitation in leaving students alone with it.

Another excellent feature is the treatment of a gravitational field first, and then later an electrostatic field where it is only necessary to give analogies with the former case. Here, generally, the Cartesian notation is used, but the Vector notation is explained without much use being made of it.

One of the most striking drawbacks of the book is the lack of an index. J. R.

LOGIC, TEACHING AND PRACTICE IN MATHEMATICS.

(1) *The Algebra of Logic.* By Louis Couturat. Authorised English Translation by Lydia G. Robinson. With a Preface by P. E. B. Jourdain. Pp. xiv+98. (London and Chicago: The Open Court Publishing Company, 1914.) Price 3*s*. 6*d*. net.

(2) *An Algebra for Preparatory Schools.* By Trevor Dennis. Pp. viii+155. (Cambridge University Press, 1913.) Price 2*s*.

(3) *Test Papers in Elementary Algebra.* By C. V. Durell. Pp. viii+233. (London: Macmillan and Co., Ltd., 1914.) Price 3*s*. 6*d*.

(4) *Practical Mathematics for Technical Students.* Part I. By T. S. Usherwood and C. J. A. Trimble. Pp. 370. (London: Macmillan and Co., Ltd., 1914.) Price 3*s*. 6*d*.

(5) *A Text-book on Spherical Trigonometry.* By Prof. R. E. Moritz. Pp. vi+67. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 4*s*. 6*d*. net.

(6) *Plane and Spherical Trigonometry* (with Five-Place Tables). By Prof. R. E. Moritz. Pp. xvi+357+67+96. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 10*s*. 6*d*. net.

(1) THIS is an excellent translation of M. Couturat's well-known "Algèbre de la Logique." The conciseness and modernity of M. Couturat's book is very apparent when we compare it with the first two volumes of Schröder's bulky, prolix, and somewhat antiquated work. The book under review is, as is remarked in the preface (p. viii.; *cf.* pp. 92–93), an exposition of the beautiful and simple calculus of symbolic logic, regarded as a branch of universal algebra. Leibnitz distinguished the two most important aspects of a symbolic language designed for purposes of reasoning, under the names *calculus ratiocinator* and *characteristica universalis*: the latter indicates broadly the route taken by Frege, Peano, Russell, and Whitehead; the former the route taken by Boole, Jevons, Venn, Schröder, and others, and is that described in the present work. Between these two routes, the "logic of relations" lies, and this is not dealt with here; but we are given a complete presentation of the important modern work of Whitehead (1898, 1901), Johnson (1901), Poretzsky (1899–1904), and Huntington (1904) on the logic of classes and propositions. Miss Robinson has added several valuable notes to her translation. The volume is neat and handy, and is an important addition to our English mathematical literature.

(2) "The development of the subject is based on psychological rather than logical principles." Here we have a sensible admission of the relation in which a text-book should stand to a scientific treatise, which the text-books of the past helped to obscure. The book consists of a series of graduated papers which exactly follow the lines of the syllabus issued by the curriculum committee of the Headmasters' Conference, and approved by the general committee of the Mathematical Association for all boys, except mathematical specialists, in public schools. There is no "bookwork," and the subject is developed wholly by means of examples; but some attempt has been made to give the pupil an impression of the existence of foundations of the subject and some sense of their nature. The very first question of the book is rather characteristic: "A boy has 5*d*. and is given 3*d*. How much has he now? How much has he if he had 5*d*. and receives x pence? . . .", and so on. The last question of this paper is: "Make up more questions like these and give the answers." This is an excellent way of teaching, and there is a freshness about the book.

(3) This is a collection of papers designed primarily for out-of-school work, and consequently includes only few graphical questions. The papers follow the traditional course of elementary algebra, along the thorny path of quadratics, logarithms, the progressions, combinations, and easy probability, up to the giddy heights of

mathematical induction and the binomial theorem. The place assigned, as is usual in text-books, to mathematical induction shows how broad is the gulf between psychology and logic. The collection should prove useful.

(4) It is pleasant to read such a practical book as this one. The authors have dealt only with those parts of mathematics which seemed to them to be of real value in practical work, and the whole book is pervaded by the spirit of Prof. Perry. The very form of the questions is refreshingly non-academic: we are concerned with the important things of life—with kilowatts, gearing, and Whitworth standard nuts. It would seem to be a mistake to give (as on p. 257) areas and volumes of certain figures, and then remark:

"The formulæ are proved most conveniently by the aid of more advanced mathematics than need be given in this volume." It warms one's heart to see (p. 5): "*A formula* is practically the simple single statement in general terms of a whole series of particular facts." It seems to us that Prof. Perry and his school are doing much incidentally to help the development of mathematics by opening our eyes to the fact that what Boole called "a premature converse with abstractions" is ruinous for a boy's whole mental life.

(5) Is simply a reproduction of the second part of (6) with a new preface. Whereas the preface of (6) gives a list of the "distinctive features" of the book, (5) states somewhat ambiguously: "Whatever unusual merit the book possesses must be largely sought for in the following points. . . ."

In (6), then, we find that, both in plane and in spherical trigonometry, triangles are solved in detail by graphical methods before analytical methods are presented, and there are many other innovations—thus, Napier's rules are proved and the three fundamental formulæ for the spherical triangle are derived simultaneously. Having read (p. v.): "The references to algebra are limited to those with which every beginner may be reasonably assumed to be familiar," we are surprised to find (p. 278) the imaginary unit defined shortly as the solution of the equation $x^2+1=0$, no evidence having been given that this equation has a solution. After this, we cannot be surprised that there is not the slightest attempt either to point out to the student the very great and fundamental difficulties that there are in the theory of convergence (see especially p. 312) or even to treat the subject correctly. The historical references are sometimes faulty: Wessel was a Dane and not a German; the trigonometrical form of a complex number is due to Euler and not to Cauchy (p. 285).

φ.

OUR BOOKSHELF.

The Schools and the Nation. By Dr. Georg Kerschensteiner. Authorised translation by C. K. Ogden. Pp. xxiv+351. (London: Macmillan and Co., Ltd., 1914.) Price 6*s.* net.

THIS is a book of exceptional interest for all who are engaged in the work of education and for those who are seriously concerned with the future social and economical well-being of the children of the nation.

It is a record of the aims and of the achievements of Dr. Kerschensteiner, of Munich, during the past twenty years in the sphere of continued education for the youth of that city. As a consequence of his assiduous enlightened effort, coupled with the ultimate goodwill of employers and employed, he has been able to establish a complete system of continued trade education for practically all the industries of Munich providing not only for the continued general education up to the close of their eighteenth year of the children leaving the elementary schools, but also for their technical training in industry and commerce combined with instruction bearing upon their daily life and duties and in relation to their future responsibilities as citizens.

The system has been gradually developed, but always in close cooperation with the City Trade Guilds, and its success has been assured by the adoption by the municipality of compulsory measures requiring the attendance of all apprentices and others engaged in employment at the courses provided within the usual working hours.

Special buildings have been erected providing for about fifty-six various industries, chiefly handicraft, many of them demanding much artistic knowledge and skill. This concrete illustration of the successful treatment of the problem of continued education deserves the most serious study.

How Man Conquered Nature. By Minnie J. Reynolds. Pp. v+249. (New York: The Macmillan Company, 1914.) Price 1*s.* 8*d.* net.

THE style of this little book will appeal to children. The language is simple without being babyish. Man's development is traced from the time when, realising the "opposition of the thumb," he threw his first stone, down to his use of a flying machine. Not unnaturally, perhaps, Miss Reynolds, in the first part of the book especially, gives great prominence to woman's part in the civilising process. We are told, for instance, "woman was the first harvester," "the first miller," "the first baker," "the first salt maker," "the first furrier," and so on.

Excelsior School Map of the United States. In four sheets. Size 62 in. by 48 in. (London: G. W. Bacon and Co., Ltd.) Mounted to hang, with rollers and varnished; or mounted, cut to fold, with eyelets. With political colouring, 15*s.*; the same with contour colouring, 16*s.*

THIS wall map is constructed on a conical projection on a scale of 1 : 3,200,000, or 50·5 miles to an inch. It is provided with an inset map of the Philippines on a scale of 1 : 7,500,000. The coast-line, rivers and lakes are in blue; the railways and sea-routes, with distances, are in red; and town names are printed in black. The general effect is excellent, and the map should meet the needs of the class-room satisfactorily.

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.*]

Forests and Floods.

SOME time ago the question of the effect of forests in checking floods was discussed in the pages of NATURE. The subject was lately recalled to my recollection while watching gardening operations in the vegetable borders. I was then much struck by the different conditions, after rainfall, of newly dug ground and ground that had lain undisturbed for a year. The gardener was proceeding to put in plants in the newly dug part, but found it much too wet to be worked in. It was suggested he might continue the digging of the rest of the border and leave the planting until later. On breaking up the undisturbed ground, it was found to be fairly dry and in quite good condition for digging. These conditions seemed to indicate that newly disturbed ground holds a much greater proportion of the rainfall than does consolidated ground in which the soil particles are more closely packed together. In the latter the water seems to pass much more freely through it than in the former, possibly due to there being a continuous water film from the surface to the water table. It not only passes more quickly to the lower level, but much more of it passes, while the disturbed ground retains a much greater proportion of it to the benefit of the vegetation.

Experiments might be made to get further information on this point by means of proper water-tight tanks filled with earth, and comparative readings taken of the drainage water in tanks in which the soil had become consolidated by rainfall and those in which the soil had been recently disturbed. As this would take a long time to accomplish, it has not been done, but perhaps some others may be induced to make the tests, as the knowledge of the subject may be useful in agricultural operations. It does not directly bear on dry farming, as that is a question mostly of surface soil mulch produced by stirring the surface soil and so breaking the water film connecting it with the subsoil. But it would seem to indicate that before dry farming can be started, the surface soil, to a depth sufficient to hold the rainfall, should first be thoroughly pulverised to prevent the rainfall passing downwards and beyond the range of the roots.

Though satisfactory tests have not been made yet I had an opportunity of making some experiments on somewhat similar lines. There were three pots full of soil lying out in the garden. These had previously been in use in some experiments with plants. The soil in all of them was alike, having been taken from the kitchen garden. These pots and soil had been lying out for more than a year; and as the soil in them was thoroughly consolidated, the question was put to them. First, the pots were all weighed; as the weather had been fine for some time, the soil was pretty dry. The pot having the medium weight was then selected, the soil emptied out, broken up, and returned to the pot. Water was now poured slowly over the soil in all the pots in 4-oz. doses at a time. The first thing noticed was that the water entered the soil of the undisturbed pots more slowly than the other, and, secondly, that the water came more quickly through the soil in these pots than through the other. Water was added to the pots until they ceased to take up any more. After draining, they were weighed again, and the result is given in the table:—

Weights in Pounds and Ounces of the Three Pots.

	No. 1. Consolidated soil	No. 2. Pulverised soil	No. 3. Consolidated soil
	lb. oz.	lb. oz.	lb. oz.
Dry	7 $9\frac{1}{2}$	7 10	7 13
Wet	8 10	9 $6\frac{1}{2}$	9 1
Water held by soil	1 $0\frac{1}{2}$	1 $12\frac{1}{2}$	1 4

It may be further mentioned that it was thought that some of the soil in the consolidated pots might not have got thoroughly wetted, owing to the water running quickly through them; the three pots were therefore afterwards put in a vessel of water to soak; they were then drained and weighed, but the result showed but little change, showing that all the pots had got as much water as the soil would hold. An examination of the above table shows that the disturbed soil holds a much greater amount of water than the consolidated soil. No definite conclusion can be drawn from these figures as to the relative retaining powers of the soil in the two conditions, as no two soils are likely to be equally affected. The only thing to be noted is that the pulverised soil has a much greater power of holding water than the consolidated.

It may be asked: what has all this to do with forests and floods? If we are correct in supposing that soil by becoming consolidated and the particles close packed, by the action of the rainfall, causes it first to resist the entrance of heavy rainfalls, and secondly, after it has entered the soil, to facilitate its passage through it to depths beyond the range of being of use to vegetation. If this be so, then anything that breaks up the close packing of the grains and stirs the soil will tend to enable the water to enter the soil, and will also tend to enable it to retain it. Now the roots of trees in forests, by their constant growth and expansion, stir the soil and prevent it getting consolidated. The soil under trees will therefore always be in the best condition for absorbing and retaining the rainfall. And the surplus is only slowly parted with to feed the drainage, whereas on bare soil, or soil on which the vegetation is poor, tends to reject the rainfall, causing the water to run off the surface, and what enters is quickly passed downwards to swell the drainage water. From the above it would appear that bare and poorly cultivated land will tend to cause floods by speedily getting quit of its rainfall, while forest land will retain and only slowly part with it. The decaying vegetation on the surface under trees has also a beneficial effect, as it absorbs water and acts as a mulch, preventing drying.

It is well known that rains in early summer, unless when torrential, give rise to small amounts of flooding compared with winter rains of the same amount. There are a number of reasons for this which our space does not admit of treating, but it is probably in part due to the stirring action on the soil of the roots of grasses and other plants, as that is the season when root action is most active.

Ardenlea, Falkirk. JOHN AITKEN.

June 29.

Proposed International Magnetic and Allied Observations during the Total Solar Eclipse of August 21, 1914 (Civil Date).

IN response to an appeal for simultaneous magnetic and allied observations during the coming total solar eclipse, cooperative work will be conducted at stations along the belt of totality in various countries and also at some outside stations.

The general scheme of work proposed by the Carnegie Department of Terrestrial Magnetism embraces the following:—

(1) Simultaneous magnetic observations of any or all of the elements according to the instruments at the observer's disposal, every minute from August 21, 1914, 10h. a.m. to 3h. p.m. Greenwich civil mean time, or from August 20, 22h., to August 21, 3h. Greenwich astronomical mean time.

To ensure the highest degree of accuracy, the observer should begin work early enough to have everything in complete readiness in proper time. See precautions taken in previous eclipse work as described in *Terrestrial Magnetism*, vol. v., p. 146, and vol. vii., p. 16. Past experience has shown it to be essential that the same observer make the readings throughout the entire interval.

(2) At magnetic observatories all necessary precautions should be taken to ensure that the self-recording instruments will be in good operation, not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. It is recommended that, in general, the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base line.

(3) Atmospheric-electric observations should be made to the extent possible with the observer's equipment and *personnel* at his disposal.

(4) Meteorological observations in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that at least temperatures be read every fifth minute (directly after the magnetic reading for that minute).

(5) Observers in the belt of totality are requested to take the magnetic reading every thirty seconds during the interval, ten minutes before and ten minutes after the time of totality, and to read temperatures also every thirty seconds, between the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in *Terrestrial Magnetism and Atmospheric Electricity*.

L. A. BAUER.

Washington, June 23.

Asymmetric Haloes with X-Radiation.

A RADIOGRAPH of a lead disc 2·5 mm. thick, raised above the plate, does not, as might be expected, appear of an even intensity, but gives well within its shadow a distinct white ring. The area inside this ring is grey, and the annular space outside it dark. Experiment has shown that its brightness, width, and diameter vary with the distances of the disc from the plate and antikathode. It also changes from a complete circle to almost a semi-circle, the position and dimensions of the absent arc depending upon the orientation of the bulb.

The ring is found to be complete when the X-rays are in the plane of the kathode rays and the normal of the antikathode, and from 10° to 15° within the angle of true reflection, *i.e.* that at which light substituted for kathode rays would be reflected. Diverging from this direction the circle becomes increasingly incomplete, the break in the curvature being always on the side furthest from it.

Apertures, cubes, cylinders, solid and hollow, spheres, etc., of various materials give analogous results, the form of the white area depending upon the shape of the object. Thus an ebonite cylinder gives this effect in addition to the peripheral bands and alternating semicircles described in former letters.

This phenomenon cannot be attributed to ordinary secondary radiation, since the ring is not dispersed by strong magnetic fields. Scattering, unless at some definite angle, is precluded by the sharpness of outline, and the asymmetry would seem to dispose of diffraction and polarisation, since the dark and light parts of the ring are opposite, and not at right angles.

It appears, therefore, that the X-radiation has been differentiated into two main types, one of which may consist of disparate doublets (magnetic); the polarity being distributed radially round a position which coincides with that of maximum intensity (Kaye). This phenomenon bears a close analogy to that of unilateral conductivity in crystals.

W. F. D. CHAMBERS.
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90 Gordon Road, Ealing.

The Composition of the Atmosphere.

MR. A. PARKER (*Jour. Chem. Soc.*, April, 1914) in a study of the inflammation of mixtures of methane with oxygen and nitrogen, has found that inflammation can be brought about more easily in mixtures containing nitrogen than in pure oxygen. In fact, the mixture which requires for ignition a minimum of methane contains only about 23 per cent. of oxygen. This unexpected result is traced to the difference in the specific heats of oxygen and nitrogen, and not to any property of methane. If one may assume that combustions at other temperatures behave in a similar manner, perhaps all slow combustions can be maintained with a minimum expenditure of energy in a mixture of oxygen and nitrogen containing about 23 per cent. of oxygen.

The close proximity of this proportion to that of atmospheric air is remarkable. Is it possible that living matter on the earth's surface has evolved its own atmosphere, as it were, so that the dissipation of the energy of metabolism may be a minimum? The temporary stimulation of animals by pure oxygen is not necessarily contrary to this hypothesis. I should be glad to know if the estimated total amount of carbon in organic matter, including coal, is equivalent to an amount of oxygen at all comparable with that in the atmosphere; or, in other words, if a large increase or decrease in the amount of organic matter on the earth could alter appreciably the proportion of free oxygen in the air.

N. P. CAMPBELL.

Trinity College, Kandy, Ceylon, June 24.

Elevation of Mouth of Harton Colliery.

WILL some reader of NATURE kindly inform the writer, through this journal, what the elevation above sea-level and the location of Harton Colliery are, where Sir G. B. Airy made his pendulum observations on the force of gravity at the mouth and bottom of that mine in 1843, and also if the result of those observations is still generally accepted as correct.

EVAN MCLENNAN.

Corvallis, Ore., U.S.A., June 20.

THE FORTHCOMING TOTAL SOLAR ECLIPSE, AUGUST 21.

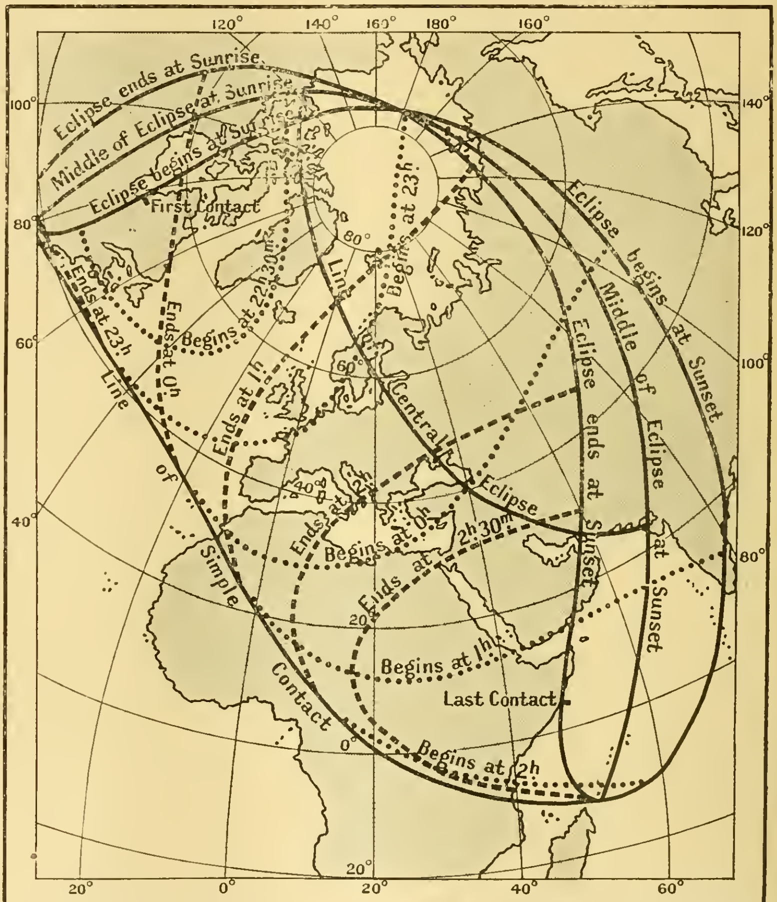
OWING to the great strides made in the study of the physics of the sun, the importance of the occurrence of a total eclipse of the sun is not so great as it was towards the latter end of last century. Nevertheless, there are still some problems to be solved, the data for which can only be obtained on these occasions, thus necessitating the organisation and dispatching of observers to several stations lying on the path traced out by the cone of the moon's shadow as it sweeps over the earth's surface.

The present year presents us with a total eclipse as near at home as that which occurred in the year 1896; in fact, these eclipses belong to the same family, and it is likely that the event in August next will be as well attended by both amateur and professional astronomers as was its forerunner. It is hoped, however, that weather conditions will be more favourable for successful observation, for it will be remembered that on the last occasion the only party that was fortunate enough to come home with results was that which took up a station in Novaya Zembla.

European observers will be especially favoured by the position of the path of the moon's shadow, because the greater portion of the accessible track cuts Europe diagonally through its central position. Thus, with comparatively little journeying, very favourable stations for observation can be reached.

The accompanying illustration (Fig. 1) shows the general position of the line of central eclipse. It will be seen that the eclipse begins at a point situated in north latitude about $71\frac{1}{2}°$ and ends in a latitude a little greater than $23\frac{1}{2}°$. The moon's shadow first strikes the earth in far north Canada, passing a little south of the Parry Islands, and pursuing its course just above Baffin's Bay. There it enters Greenland, and sweeps across this sparsely-inhabited region and emerges into the Arctic Ocean. Taking a south-easterly trend, it enters Norway near the island of Vega, and passes out of Sweden near Hernösand, and then crosses the Gulf of Bothnia and the Baltic Sea. The track then enters Russia at Riga, and passes near Minsk, Kiev, and the eastern part of the Crimea, crossing the Black Sea and reaching the opposite coast at Trebizond. It then traverses eastern Turkey and western Persia, and terminates its course on the north-west coast of India.

There is little doubt that the first portion of the eclipse track—that is, the part that crosses the islands north of Canada and Greenland—will not be occupied by special observers. From Norway south-eastwards the case will be different, for there the sun will be at a useful altitude and the eclipse of long duration. On the west coast of Norway the sun will have an altitude of a little over 35°, and the duration about 126 seconds. On the east coast of Sweden the altitude will be more than 36·5°, and the duration 128 seconds. In the region about the Gulf of Riga the sun's altitude will be about 39·5°, and the duration 133 seconds. By the time the Crimea is reached the altitude will be somewhat reduced, namely, 36° 40′, and the duration diminished to 129 seconds. An excellent large-scale chart of the whole track of the eclipse across Europe accompanies Count de la Baume Pluvinel's article which appeared in the March number of the *Bulletin de la Société Astronomique de France*, and this should be consulted by all who wish to take up a suitable position on the track. Those who proceed to Norwegian stations will find some useful data published recently in the *Observatory* by Prof. H. Geelmuyden. There it is stated that among



Stanford's Geog! Estab! London

FIG. 1.

stopping places for the ordinary coast steamers, going out from Bergen or Trondhjem, may be named Sannessjöen, situated on the north end of the Alsten Island, from which stations near the central line will be easily accessible, either on the same island or (by motor boat or local steamers) on some other islands towards the north-west. From Mosjöen, situated at the end of the deep Vessen Fjord, stations near the central line in the Vessen valley may be reached by carriage. Brönnö is a stopping place not far from the southern limit, and Bodö is a little outside the northern limit. Details concerning the path of the shadow track across Turkey and Persia and the accessible places for forming camps in these countries have been described by Prof. David Todd in these columns (vol. xciii., p. 311, May 21), so that further reference to these regions becomes unnecessary.

With regard to the weather conditions that will be experienced, the probability of fine weather seems to increase the further east along the track the station is taken up. According to the information that is to hand, most of the main official expeditions will be located along the Russian portion of the line, where the good weather chances are more promising, but this should not deter others from occupying Norwegian or Swedish stations, for the more scattered the observers are the more chance there is of some results being secured.

As to the actual expeditions that are in active preparation, the following statements may be made, and the accompanying map (Fig. 2) will help to indicate the positions of the stations which will be utilised. Dealing first with the British parties, the joint permanent eclipse committee of the Royal and Royal Astronomical Societies is sending out five observers. Three of these observers, namely, Prof. Fowler, Mr. W. E. Curtis, and Major Hills, will be stationed near Kief in Russia, and will undertake the photography of the spectrum of the chromosphere during the

FIG. 2.

partial phases, using the iron arc as a comparison spectrum. For this purpose a grating will be used giving much higher resolving power than any previously employed during an eclipse. Fathers Cortie and O'Connor are being sent to Hernösand in Sweden and will undertake direct photographs of the corona and photographs of the spectrum of the corona with special regard to the yellow and red regions. They will be accompanied by Messrs. J. J. Atkinson and G. J. Gibbs as volunteer helpers.

From the Royal Observatory, Greenwich, two observers, Messrs. Jones and Davidson, will take up their station at Minsk, in Russia. The programme of this party will consist in securing large-scale photographs of the corona, the spectrum of the corona and chromosphere, more especially in the ultra-violet region, and photographs of the corona through "mercury-green" glass for investigation of the distribution of "coronium." Near Feodosia, in the Crimea, the party from the Solar Physics Observatory, at Cambridge, namely, Prof. Newall, Mr. Stratton, and Mr. C. P. Butler, will take up their stations. The work that will be undertaken includes small- and large-scale direct photographs of the corona for extensions and details respectively, objective grating photographs of the chromosphere for comparison with the slit spectra taken by Prof. Fowler's party, and lastly, polariscopic observations.

Feodosia will also be the observing station of two German expeditions, namely, one from the Astrophysical Observatory at Potsdam, and a second from the Royal Observatory in Neubabelsberg, near Berlin. Near Feodosia, at Starg Krym, an expedition from the Hamburg Observatory in Bergedorf will take up its position. The programme of the work to be undertaken by this expedition, kindly communicated by the director, Prof. R. Schorr, includes photographs of the corona with telescopes of focal lengths of 4, 10, 20, and 40 metres, with and without screens, a search for intermercurial planets, and photographs of the spectra of the chromosphere and corona.

In addition to the above, Prof. Miethe, of the photochemical laboratory of the Technical High-school in Berlin, is going to Sannessjöen, Alsten Island, in Norway, and it is quite possible that parties from other German observatories may swell the number of expeditions.

Feodosia will also be the selected spot for three French missions, details about which have been kindly communicated by Count de la Baume Pluvinel. Count de la Baume Pluvinel himself leads a private expedition, with Messrs. Senouque and Rougier as his assistants. Their instrumental equipment will consist of a two-mirror coelostat worked in conjunction with objectives of 12 and 3 metres for the photography of the corona. Two slit spectroscopes and two prismatic cameras with flint and quartz prisms will also be used, and measures will be made of the intrinsic brightness of different portions of the corona.

A second expedition is that which will set out from the Nice Observatory under the direction of M. H. Chrétien. M. Chrétien will be accompanied by M. Lagrula, and they will take up a position at Feodosia. Their main instrument will be a coelostat with two mirrors, one of which will feed an objective of 6 metres focal length, for securing photographs of the partial phases and of the corona, the other supplying light to a slit spectroscope for the study of the rotation of the corona. M. Chrétien proposes also to make photometric measures during the partial phases. M. Jekhowsky will also join this party, and will use a concave grating of 6 in. diameter and 7 metres radius of curvature for the study of the spectrum of the chromosphere in the ultra-violet.

M. Salet, of the Paris Observatory, is also going privately to Feodosia. He will use both an equatorial and a coelostat, and his chief endeavour will be the photographic study of the polarisation of the light of the corona.

Feodosia is also the station that Dr. Perrine will observe from, and of the expedition being organised by the Lick Observatory under Prof. W. W. Campbell one section will proceed to Kief while the other will occupy Feodosia. A Russian party under Dr. Donitch will also take up quarters at the latter place.

While most of the expeditions are concentrating at Feodosia, it is hoped that other intending observers will take up positions further north. No doubt several amateurs, both British and foreign, are completing their plans for the event.

The eclipse committee of the British Astronomical Association, of which Mr. G. F. Chambers is chairman, have been endeavouring to organise parties for different stations. From information received, it seems likely that the Royal Mail Company's *Arcadian* will convey numerous members to Norwegian coast stations, while Hernösand, on the coast of Sweden, is likely to claim about a dozen; and Riga, in Russia, perhaps a somewhat larger number. It is probable also that a small number will go to the Crimea, enticed by the more favourable prospects of possibly finer weather conditions. It is interesting to note that while a total solar eclipse does not offer very much scope for the use of colour photography, yet several attempts are going to be made with small instruments. Writing from the Nikolai chief observatory at Pulkovo, Prof. Backlund (*Astr. Nach.*, No. 4740) states that, after a conference with the Minister of Finance, every facility will be offered by the Government to further the interests of the various expeditions proceeding to Russia, and that all instruments will be customs free provided observers return with them.

William J. S. Lockyer.

INTERNATIONAL FISHERY INVESTIGATIONS.[1]

The official reports on the work of the International Council for the study of the sea contained in the three volumes now under review mark a definite and important stage in the history of that undertaking, since for the first time recommendations on a considerable scale are put forward for international legislation dealing with the fisheries of the North Sea. From the commencement of the international undertaking particular attention has been directed to the plaice fisheries, and it is in connection with these that we now have not only a considerable part of Prof. Heincke's general report, but also a series of resolutions agreed to by the whole Council, which may be supposed to have resulted from

[1] Conseil permanent international pour l'exploration de la mer. Rapport et Procès-Verbaux des Réunions, vols. xvi., xviii., and xix.

a consideration of that report. It must, however, be admitted that both the report and the resolutions are in many ways disappointing. The former has already been referred to in the pages of Nature (April 23, 1914, p. 201). The recommendations put forward are that, as an initial measure, a minimum international size-limit of 20 centimetres (8 in.), below which it would be illegal to land plaice, should be imposed, and that during the spring and summer months (April 1 to September 30 in each year) this limit should be increased to 22 centimetres. A perusal of the reports suggests that the council itself scarcely contends that such a small size-limit can produce any very marked result, since, as a matter of fact, a very small percentage of fish under these sizes is at present landed. The idea seems to be that by commencing with a small size-limit it will be possible to raise it gradually without producing any serious disturbance of the fishing industry. The recommendations are, however, really an admission that a size-limit which would be effective in preventing the great destruction of small plaice by steam trawlers on the eastern grounds of the North Sea is not practicable from the point of view of the fishing industry as a whole, which is very much the conclusion arrived at by the various Parliamentary committees which have inquired into the matter in this country in past years. So far as one can see, the only practical effect of the present proposals will be to harass the very poorest class of fishermen, generally old men who get a precarious living by working in a small way in estuaries and inshore waters, and do an infinitesimal amount of damage compared with what is done by the large trawlers. Whether the proposals will, or ought to meet with greater favour at the hands of our Parliamentary legislators than their predecessors have done, is open to very considerable doubt.

Apart from the question of plaice, the most important reports in the volumes we are considering are those by Dr. Johs. Schmidt on eel investigations for 1913, by Dr. Ehrenbaum on the mackerel, and by the late Dr. P. P. C. Hoek, whose recent death will be a cause of deep regret to all fishery investigators, on the pilchard or sardine. With regard to Dr. Ehrenbaum's report on the mackerel, it must be admitted that the the new facts and observations brought forward are not extensive, and the fact that the author is dealing throughout with the reports and writings of other observers rather than with a fishery of which he has himself any great personal knowledge somewhat detracts from its value. The same criticism applies to a large extent also to Dr. Hoek's report. Any weakness of the reports due to this cause would seem to be due to the policy of the International Council in spending considerable sums of money each year in having such reports produced, money which one would imagine could be better employed in carrying out original investigations in the areas where the fisheries take place.

In conclusion, we may direct attention to the summary of the work done by the International Council during the ten years 1902–12, edited by Commander Drechsel, the general secretary, which constitutes pp. 1–83 of vol. xvi. This should be of use to those who are interested in the work which the international cooperation has accomplished.

NOTES.

We regret to learn of the death, on Sunday last, July 12, of the Rev. Osmond Fisher, the well-known geologist, in his ninety-seventh year.

The honorary freedom of Newcastle-on-Tyne was conferred on the Hon. Sir C. A. Parsons on July 10 in recognition of his achievements in science, particularly as the inventor of the steam turbine. It had been decided to confer a similar honour on Sir Joseph W. Swan, but he has since died. The symbols of the freedom—a scroll and casket—have, however, been presented to a representative of his family.

A rumour, based on a misunderstanding of a telegram from Captain Bartlett, who is at Nome, Alaska, reached London last week, announcing a disaster to the Stefansson Arctic Expedition, which left Canada last year with the object of exploring the vast uncharted regions between the north of Canada and Siberia and the north pole. A party, including three members of the scientific staff, was said to be missing. Later information received from Captain Bartlett shows that he is not aware that any disaster has occurred.

The excavation of the Dewlish elephant-trench is still unfinished, but when the excursion of the Dorset Field Club took place on June 30 it was clear that the "trench" was not artificial. Instead of ending below in a definite floor it divides downwards into a chain of deep narrow pipes in the chalk. A few bones of *Elephas meridionalis* had been found, but no clear trace of man. We shall wait with interest the completion of this work, which is proving more arduous than had been expected.

In order to provide opportunities for the more complete investigation of the nature and causes of human disease and methods of its prevention and treatment, Mr. John D. Rockefeller has just given 510,000*l.* to the Rockefeller Institute for Medical Research. This gift is in addition to a special fund of 200,000*l.* which Mr. Rockefeller has provided in order that the institute may establish a department of animal pathology. Mr. Rockefeller's previous gifts to the institute amounted to about 1,800,000*l.*, exclusive of real estate in New York City, so that the endowment of the institute amounts now to more than 2,500,000*l.*

On Thursday last, Sir Clements Markham unveiled at Cheltenham a statue of Dr. Edward Adrian Wilson, who was born in that town, and perished with Captain Scott on the great ice barrier in March, 1912. The statue, which stands in a prominent position on the Promenade, was designed by Lady Scott, and executed under the superintendence of Messrs. Boulton, a local firm of sculptors. It represents Dr. Wilson in polar dress, hands on hips, in a natural, careless attitude, and is an excellent likeness. A brass plate let into the stone base bears an inscription recording the heroism of the members of the expedition who perished with him.

MR. J. FOSTER STACKHOUSE has sent us a copy of a circular letter relating to the British Antarctic and Oceanographical Expedition being organised by him. The circular states that the expedition will leave England towards the end of the year for the following purposes:—(1) To investigate reports of mariners as to the existence of dangerous uncharted rocks, shoals, reefs, islands, etc., on the trade routes of the world; (2) to discover the extent and position of the coast line still left unmapped on the continent of Antarctica; (3) to make a scientific survey of the sea in general. This programme, we need scarcely point out, is ambitious enough for half a dozen expeditions, and we should be glad to know the names of men of science associated with it, either as members of Mr. Stackhouse's advisory committee or of the proposed undertaking.

DR. W. S. BRUCE left Edinburgh on Thursday, July 9, on an expedition to Spitsbergen. The object of the expedition is hydrographic and geological research in Wybe Jansz Water, or Stor Fiord, where the coast is little known, and where there are practically no soundings. Geological investigations will form an important item in the programme. Dr. Bruce is to be assisted by Mr. J. V. Burn Murdoch, who has previously twice accompanied him to Spitsbergen, by Mr. R. M. Craig, of the geological department of the University of St. Andrews, and by Mr. J. H. Koeppern, zoologist. He will be himself responsible for the conduct of the hydrographic work. The expedition is expected to be absent for about two months. It is supplied with instruments by the Admiralty and the Scottish Oceanographical Laboratory, and is also supported by the Royal Geographical Society and the Prince of Monaco.

AT the twelfth annual general meeting of the British Academy, held on July 10, Lord Bryce, who was in the chair, urged that the academy should have the means of encouraging and aiding inquiries of real value which cannot be materially profitable to those who undertake them, and of paying for the publication of works needed by students but which cannot be expected to command a remunerative sale. Ample justification, he said, for such grants would be found both in the practice of the chief nations of Continental Europe and in that followed as respects scientific inquiries, grants for which are made to the Royal Society to be administered by that body. Lord Haldane, Lord Fitzmaurice, and Mr. John W. Mackail were elected new fellows by ballot, and the following were elected corresponding fellows:—M. Charles Bémont, Mr. C. W. Eliot, M. Omont, and Signor Pasquale Villari. Lord Bryce was re-elected president, and Canon Charles, Prof. Percy Gardner, Sir Courtenay Ilbert, Prof. W. P. Ker, and Prof. W. R. Sorley were appointed members of the council.

THE annual meeting of the British Medical Association will be held this month at Aberdeen. The president's address will be delivered on July 28 by Sir Alexander Ogston, K.C.V.O. The address in medicine will be given by Dr. A. E. Garrod, and that in surgery by Sir John Bland-Sutton. Prof. J. Arthur Thomson will deliver the popular lecture. The scientific business of the meeting will be conducted in sixteen sections, which, with the names of the presidents, are as follows:—Anatomy and Physiology, Prof. R. W. Reid; Dermatology and Syphilology, Dr. A. Eddowes; Diseases of Children, including Orthopædics, Dr. J. Thomson; Electro-Therapeutics and Radiology, Dr. S. Sloan; Gynæcology and Obstetrics, Dr. F. W. Nicol Haultain; Laryngology, Rhinology, and Otology, Dr. H. Lambert Lack; Medical Sociology, Dr. J. Gordon; Medicine, Dr. F. J. Smith; Naval and Military Medicine and Surgery, Surgeon-General W. M. Craig; Neurology and Psychological Medicine, Dr. F. W. Mott; Ophthalmology, Mr. C. H. Usher; Pathology and Bacteriology, Dr. W. S. Lazarus-Barlow; Pharmacology, Therapeutics, and Dietetics, Prof. J. T. Cash; State Medicine and Medical Jurisprudence, Prof. Matthew Hay; Surgery, Mr. J. Scott Riddell, Tropical Medicine, Prof. W. J. R. Simpson.

THE *Eugenics Review* for July (vol. vi., No. 2) contains many articles of general interest. Mr. Nettleship reviews the results of consanguineous marriages, and concludes that those between cousins are as safe from the eugenic point of view as any other marriages, provided the parents and stock are sound. Mr. Macleod Yearsley deals with the problem of deafness and its prevention. The chief causes of acquired deafness are meningitis, fevers and other infective diseases, such as tuberculosis and syphilis, and adenoids and similar throat conditions. The prevention of acquired deafness therefore largely rests with efficient treatment in the fever hospitals and with medical inspection and treatment of school children.

IN the third part of that excellent periodical, *Ancient Egypt*, the editor, Prof. Flinders Petrie, gives an authoritative account of the discovery of the famous treasure of Lahun, in a tomb which had been already plundered, probably in the decadence of the kingdom before the Hyksos. The splendid diadem and two pectorals, one bearing the cartouche of Senusert II., the other that of Amenamhat III., are specially noteworthy. The same scholarly explorer contributes the first part of an article which, by reference to the work of recent travellers, provides material for the comparison of Egyptian funerary rites with those of the modern Bantu and other African races—a piece of work which throws important light on many anthropological problems.

IN the review of "Maya Art" in NATURE of July 2 (p. 456), in referring to Maya chronology, the statement was made that the number 13 "is based upon the fact that eight years of 365 days are exactly five years of the planet Venus." Mr. A. E. Larkman writes from Southampton to suggest that there is a discrepancy in this statement. The reviewer regrets having omitted to say that the five years of the planet

Venus refer to its synodic (not sidereal) revolutions of 583·9 days each, the only "Venus year" which the Mayas could appreciate, unless they had knowledge of the heliocentric system ($8 \times 365 = 5 \times 584 = 2920$). The justification of the number 13 as given on p. 456 is therefore good enough for a people who were great worshippers of the morning and evening star, of the representations, symbols, and attributes of which their almanacs are full. This and further detail is discussed fully in Foerstemann and Seler's collected and translated papers, published by the Smithsonian Institution, Washington, 1904.

A JOINT meeting of the British Psychological Society, the Aristotelian Society, and the Mind Association was held at Durham on July 3–6. A discussion of considerable interest to psychology took place on the rôle of repression in forgetting. In it was considered Freud's view that in forgetting, even among normal people, an important part is played by the factor which he terms "repression." There appeared to be distinct agreement among the speakers that forgetting, both of the ordinary and the pathological kind, while sometimes attributable to defects of retention, is frequently incapable of explanation without the assumption of positive factors which prevent recall of the retained matter. The nature of these positive forces, as they are treated by Freud, was discussed at length. Mr. Pear held that two kinds of forgetting should be distinguished, one due to failure to retain (the conditions for which may be purely physiological in character), the other to failure to recall. The latter condition may be due to psychological factors, some of which are possibly of the kind described by Freud. Dr. Wolf's paper criticised the use of the term "repression." Dr. Mitchell expounded in detail Freud's theory of hysterical amnesia, while Prof. Loveday criticised Freud's general conceptions, especially that of unconscious thought, pointing out the defects which were entailed by an adherence to the old doctrine of associationism. Dr. Ernest Jones and Dr. Crichton Miller supported Freud's theory by facts from clinical experience. Among other speakers were Mr. W. McDougall, Prof. T. P. Nunn, Prof. G. F. Stout, and Dr. H. Wildon Carr.

WE have received from Mr. H. Swithinbank and Mr. G. E. Bullen a copy of a paper entitled "The Scientific and Economic Aspects of the Cornish Pilchard Fishery: ii., The Plankton of the Inshore Waters in 1913 considered in Relation to the Fishery." Samples of plantkon were taken at twelve stations in Mevagissey and St. Austell Bay, at eleven stations in Mount's Bay, and at six stations in St. Ives Bay, on June 1–3, 1913, and similar collections were made at a number of these stations in August of the same year. The principal species found in the samples have been identified and recorded. The paper also contains some notes on the pilchard fishery during the season.

THE reports of the Albany Museum, Grahamstown, for the years 1910–13 are issued in a single cover. In that for 1910, the director reviews the condition of the building and collections at the time he assumed control, in the course of which he compliments the late director and his staff on their efforts to improve the museum, although hampered by insufficient funds. On a later page the preparation and publication of a series of works on the entire South African fauna is urged, those at present in existence being more or less obsolete. In the report for 1913 large additions to the collections are recorded, which render the need of extension of the building more pressing than ever.

To prevent the deaths of migrating birds from exhaustion while fluttering around the lanterns of lighthouses, the Royal Society for the Protection of Birds a short time ago placed perches near the lanterns at St. Catherine's and the Caskets. The perches are made in the form of a small ladder of wood and iron within view of the light, but so placed as not to obstruct it. Observations have shown that these perches were crowded every night during the migrating season. Trinity House has now permitted the society to furnish other lighthouses with similar accommodation, and the next so to be treated are the South Bishop, off Pembrokeshire, and that at Spurn Head, where the work will be completed this summer.

A NOTICE of the English supplement, based on the second edition of "Jost's Lectures on Plant Physiology," appeared recently in these pages on May 7, and we now direct attention to the publication, by Mr. Gustav Fischer, of the third German edition of this work. The forty-two lectures which comprise the volume occupy 744 pages of text, and the various branches of the subject have been thoroughly revised up to the date of publication. Attention may be more particularly directed to the full treatment of hybridisation and plant-breeding in lectures 29 and 30 of this new edition. The work is on the whole so comprehensive and representative that it is a matter of regret that the subject of protoplasmic connections is somewhat inadequately treated, but it must be admitted that blemishes such as this are rare. Jost's lectures hold the position of pre-eminence as a standard presentation of the science of plant physiology, and the book is all the more valuable since the facts are presented in a particularly interesting manner.

WE have received the first part of the *Annals of Applied Biology*, the newly-founded official organ of the Association of Economic Biologists. Prof. Maxwell Lefroy, assisted by a strong committee, acts as editor, and the magazine is published by the Cambridge University Press. The number contains a varied selection of articles; perhaps the most important is Mr. A. E. Cameron's detailed account of the life-history of *Pegomyia hyoscyami*, known most widely by one of its several synonyms—*P. betae*—the mangel-fly. The leaf-mining maggot is here described in its successive stages. Mr. F. V. Theobald writes on the green spruce aphis (*A. abietina*), an insect very destructive in England and Ireland, but apparently rare on the Continent, and not certainly known in Scotland. All naturalists, whether specially interested in "economic" questions or not, should read Prof. F. W. Gamble's suggestive article on impending developments in agricultural zoology.

At the conclusion of an article on the African element in the fresh-water fauna of India, published in the report of section 4 of the *Compte rendu* of the ninth International Zoological Congress, held at Monaco in 1913, Dr. Annandale remarks that the existence of this African element is more pronounced among lower invertebrates than in other groups. Admitting the existence in late Cretaceous and perhaps early Tertiary time of a land-bridge between the Malabar coast of India and East Africa, and of a second connecting Africa with South America, he argues that at this period India, Africa, and South America doubtless possessed a very similar fresh-water fauna, of which Africa formed the central area. Any land-passages from India to South America must almost certainly have included Africa; and the occurrence of similar generic types only in the two former areas must be explained by their dying-out in the third. Madagascar, if ever united with the tri-continental tract, must have been separated at an earlier date than the other constituents.

For some years past Mr. Roy Andrews has been engaged in investigating the whale and whale-fisheries of the North Pacific; and it has been decided to publish the results of these investigations in a series of monographs in the Memoirs of the American Museum of Natural History. In the first of these (ser. 2, vol. i., part 5) the author deals with the grey whale (*Rhachianectes glaucus*), of the Californian and Japanese seas, which is the sole representative of its genus, and is now shown to be the most archaic type of whalebone-whale in existence. Its most strikingly primitive features include the presence of scattered hairs over the whole head, the small number, shortness, thickness, and wide separation of the plates of whalebone, the persistence of a wide strip of the frontal bones on the vertex of the skull, and the length of the nasals, the retention of stout neural arches by the first two cervical vertebræ, which, like the other five, are completely free, the length and straightness of the humerus, and the large size of the remnants of the pelvis. In several of these respects the genus, which Mr. Andrews considers should represent a family by itself, approximates to Plesiocetus of the European Pliocene.

To the April number of the *American Museum Journal* Prof. H. F. Osborn communicates a note on the collection of Permian South African reptiles just acquired by the museum from Dr. R. Broom. The author remarks that these reptiles represent the climax of development of the amphibian stock, and the first attempts at progression on land. Reptiles of this early type are common to South Africa, Texas and New Mexico, and part of Russia, those from the first and last localities being much more nearly related than are those from America to either. "The Texan reptiles continued to crawl close to the ground, but in South Africa we find that in many of the groups, through a powerful development of the limbs, the body is raised well off the ground—a distinct advantage which gave the start that resulted in the development of mammals." In the course of a letter in the same issue on the work of field-collectors, Col. Theodore Roosevelt remarks that he particularly wishes "to avoid seeing growing up in the United States the type of scientist who merely supplies the nomenclature and technical descriptions for specimens furnished him by field-observers." No mention is made of the sportsmen, who, on the strength of the merest smattering of zoological knowledge, nowadays feel themselves qualified to discuss the affinities and nomenclature of game animals.

The importance to science of accurately expressed terms and definitions could scarcely be enforced more clearly than in the case of seismology. Mallet, for instance, bequeathed to us the term *seismic focus*. Later writers have used the word *hypocentre* as an equivalent term, and *epicentre* for the projection of the hypocentre on the surface. All three terms imply that the region within which an earthquake originates is a point, or practically a point. Yet Mallet himself did not hold this view, for he regarded the focus of the Neapolitan earthquake of 1857 as a vertical fracture several miles long in both directions. The subject has lately been discussed by Dr. G. Martinelli in an interesting paper (*Mem. della Pont. Accad. Rom. dei Nuovi Lincei*, vol. xxxi., 1913). Dr. Martinelli also considers some recent inquiries as to the form of the hypocentre, and concludes that the "Herdlinien" of Harboe and the "seismotectonic lines" of Hobbs have little, if any, physical meaning. He is in favour, however, of retaining the term hypocentre as denoting the limited region within which the initial disturbance takes place.

The Director-General of Observatories (India) has issued a memorandum (dated Simla, June 8) on the meteorological conditions prevailing before the advance of the south-west monsoon. Records of the past show that the monsoon rainfall of India is affected by previous conditions over various parts of the earth, *e.g.* high barometric pressure during March–May in Argentina and Chile, and low pressure in May in the Indian Ocean are favourable conditions, while high pressure in India in May is advantageous for Malabar, and possibly Mysore, but unfavourable for other parts. Among the inferences drawn from available data are: (1) that, on the whole, the total monsoon rainfall this year will probably be somewhat less abundant than usual, at any rate in the earlier part of the season; (2) as regards geographical distribution, during the first half of the monsoon period, while local conditions are favourable for the Malabar coast, they are somewhat unfavourable for several other parts.

We have received from Prof. A. McAdie, director of the Blue Hill Observatory (Massachusetts), an appreciative review of the scientific work of the late Prof. A. L. Rotch, published (apparently) in the Annals of Harvard College. Many of the facts referred to are already known to our readers; Prof. Rotch was the founder, and for more than twenty-seven years director, of the observatory. The upper-air records obtained by him have been of great service in the study of various meteorological problems, and a list of 183 of his principal articles and memoirs are given in Prof. McAdie's notice.

A CONVENIENT method of determining the melting or solidifying range of temperature of a lava or similar substance, which on account of its want of homogeneity must be tested in bulk, is described by Messrs. K. Fuji and T. Mizoguchi in the March number of the Proceedings of the Tokyo Physical Society. The material to be tested is placed in the form of powder in an earthenware crucible of about 50 c.c., and is heated in an electric resistance furnace. The temperature is measured by a standardised platinum platinum-rhodium couple, and the electrical conductivity by the current sent by an alternating electromotive force applied to two spherical platinum electrodes immersed in the molten material. The apparatus is standardised by the use of fused sodium chloride. According to the measurements made by the authors, the conductivity of molten lava may exceed 0·5 reciprocal ohms per centimetre cube, and may therefore influence the propagation of electric waves over that part of the earth's surface beneath which it is present.

IN the July number of *Science Progress* the editorial article entitled "Irrationalism" is a strong condemnation of the position taken up by the anti-vivisectionist. "Irrationalism," it is truly urged, "is generally the enemy of humanity. In the form of crankism it clings shrieking to the hands of science just when she is engaged upon her most difficult but beneficent labours, and, in the form of political party, it paralyses the efforts of the wisest legislators." The age of the earth is discussed by Prof. J. Joly, whilst Mr. H. S. Shelton, dealing with the same subject, brings forward arguments, with which probably most chemists will agree, to show that sea-salt data are unsatisfactory as a basis of calculation of geologic time. Mr. Arthur Holmes considers the terrestrial distribution of radium, which bears upon the same problem. Articles of general interest are contributed by Dr. J. J. Jenkins on scientific research and the sea-fisheries, by Mr. W. R. G. Atkins on some recent work on plant oxidases, and by Mr. R. Steele on photographic and mechanical processes used in the reproduction of illustrations.

THE fourth article on the Ford motor-car works in the *Engineering Magazine* for July describes the methods adopted for assembling motors and their components. It is common practice in these works to place the most suitable component on elevated ways or rails, and to carry it past successive stationary sources of component supply, and past successive groups of workmen who fix the various components to the principal component, until the assembly is completed and ready to leave the assembling line. A slow-moving chain is used in certain cases to drive the assembly in progress along the rails. The following figures will illustrate the saving in time effected: Motor assembling on separate benches gave, in October, 1913, 1100 men working 9 hours to assemble 1000 motors. On full-length motor-assembling lines, in May, 1914, 472 men working 8 hours assembled 1000 motors. It will be understood that elaborate systems of making all parts to gauge and of rigid inspection of the finished components contribute largely to these results.

AMONG the papers read at the Paris meeting of the Institution of Mechanical Engineers last week is one on signalling on railway trains in motion, contributed by the engineers of six of the French railways. On the Nord, a fixed ramp is set in the centre of the track parallel to the rails, and at a distance from the signal varying from the foot of the signal to 200 metres. The oak beam forming the ramp carries a cover-plate of brass; a stout square piece of copper is riveted to the plate and is connected to the wire from the battery. Cushions of tarred felt are placed between the ramp and the sleepers so as to reduce vibrations due to trains passing. The locomotives carry an electro-automatic whistle, the steam or compressed-air valve of which is operated by a strong spring and a Hughes electromagnet. A brush on the locomotive formed of a series of small brooms of hard elastic copper, wire connects the electromagnet through the ramp to the battery; the other wire goes to earth through the wheels and rails. The signal vane is provided with a switch which controls the position of the signal vane as well as releases the whistle. All the installations described in the paper must be regarded as being in the experimental stage.

WE have received a copy of "The Leather Trades Year Book," the official publication of the United Tanners' Federations of Great Britain and Ireland. The year-book is published at 3*s*., and can be obtained from the hon. editors, 176 Tower Bridge Road, London, S.E. It contains a large number of statistical data for the last five years of hides, tanning materials, and leather-made goods, and a series of illustrated articles dealing with the science and practice of the leather industry.

AMONG recent additions to the "Cambridge Manuals of Science and Literature," published by the Cambridge University Press at 1*s*. net each, the following deserve mention. One by Dr. R. A. Sampson, Astronomer Royal for Scotland, has the title, "The Sun," and provides in its 141 pages a brief statement of the present position of fact and theory relating to the sun. The second is by Mr. T. C. Cantrill, and deals with coal mining. He outlines the evolution of the industry from its primitive beginnings, and indicates some of the far-reaching effects it has had on domestic and mechanical affairs. The third book, "The Making of Leather," is by Mr. H. R. Procter, who gives a sketch of the methods and some discussion of what is a very ancient industry, involving in its explanation some difficult branches of human knowledge.

OUR ASTRONOMICAL COLUMN.

COMET 1914*c* (NEUJMIN).—Prof. H. Kobold contributes to a supplement to *Astronomische Nachrichten* (No. 4748) the elements and ephemeris of the comet most recently discovered, namely, comet 1914*c* (Neujmin). The observations of July 1, 2, and 3 were utilised and a parabolic system of elements was computed. The elements are as follows: —

Elements.

T = 1914 Feb. 11·518 Berlin M.T.

$$\left.\begin{aligned}\omega &= 289^\circ\ 2'\!\cdot\!0'\\ \Omega &= 265^\circ\ 45'\!\cdot\!3'\\ i &= 36^\circ\ 19'\!\cdot\!3'\end{aligned}\right\} 1914\cdot0$$

log q = 0·13179

The comet is getting very faint, but for those with larger telescopes the following ephemeris may be useful :—

	R.A. (true) h. m. s.	Decl. (true) ° ′	Mag.
July 16	17 50 2	−9 30·6	12·9
17	49 24	21·6	
18	48 48	12·9	
19	48 13	9 4·5	13·0
20	47 41	8 56·3	
21	47 10	48·5	
22	46 41	41·0	
23	17 46 14	−8 33·8	13·1

COMET 1913*f* (DELAVAN).—For the last few months comet 1913*f* (Delavan) has been lost in the sun's rays, but it will soon now become visible again, and it is expected that it may appear as a naked-eye object. Numerous elements, both parabolic, elliptic, and hyperbolic, have been computed by different workers. Thus Dr. G. van Biesbroeck advocates parabolic elements (*Astronomische Nachrichten*, No. 4739) as follows :—

T = 1914 Oct. 26·3000 Berlin M.T.

$$\left.\begin{aligned}\omega &= 97^\circ\ 28'\ 17''\!\cdot\!4\\ \Omega &= 59^\circ\ 8'\ 46''\!\cdot\!4\\ i &= 68^\circ\ 1'\ 46''\!\cdot\!4\end{aligned}\right\} 1910\cdot0\ (\text{Osc. 1914 Sept. } 28\cdot0)$$

log q = 0·0430113

Herr E. E. Kühne calculates his ephemeris (*Astronomische Nachrichten*, No. 4739) on the basis of elliptic elements, which he gives as follows :—

T = 1914 Oct. 26·5626 Berlin M.T.

$$\left.\begin{aligned}\omega &= 97^\circ\ 27'\ 8''\!\cdot\!7\\ \Omega &= 59^\circ\ 10'\ 16''\!\cdot\!3\\ i &= 68^\circ\ 6'\ 23''\!\cdot\!6\end{aligned}\right\} 1914\cdot0$$

log q = 0·043697

e = 0·999655

Messrs. S. B. Nicholson and C. D. Shane (*Lick Observatory Bulletin*, No. 255) do not consider a parabolic orbit to be included within the range of possible solutions, and so advocate a set of hyperbolic elements on which their ephemeris is based. The following are the elements they give :—

T = 1914 Oct. 25·8690 Greenwich M.T.

$$\left.\begin{aligned}\omega &= 97^\circ\ 25'\ 06''\!\cdot\!7\\ \Omega &= 59^\circ\ 12'\ 41''\!\cdot\!2\\ i &= 68^\circ\ 00'\ 36''\!\cdot\!9\end{aligned}\right\} 1914.0$$

q = 1·10333

e = 1·00163

The following ephemeris for the current week is based on the computations of Dr. G. van Biesbroeck :

	R.A. (true) h. m. s.	Decl. (true) ° ′ ″	Mag.
July 16	5 22 31	+33 52 3	6·8
17	24 51	34 10 16	
18	27 14	34 28 36	6·7
19	29 38	34 47 4	
20	32 6	35 5 40	
21	34 35	35 24 24	
22	37 7	35 43 16	6·6
23	5 39 42	+36 2 16	

Attention may be directed to a communication to the Royal Academy of Belgium (*Bulletin de la Classe des Sciences*, 1914, No. 2, p. 101) by Dr. G. van Biesbroeck. In this the author discusses in detail the elements and positions of the comet, and gives an interesting chart of the positions of the comet in the sky (with the sun's positions) extending from September 1, 1913, to July 1, 1915.

CLASSIFICATION OF NEBULÆ AND STAR CLUSTERS.—Those who have observed or photographed a large number of nebulæ and star clusters have no doubt experienced the difficulty of classifying them briefly without having to describe each in detail. Nearly every astronomer who has had to deal with a large number of these objects has either adopted a previous system of nomenclature or has formed one of his own based partially on one previously selected. The time seems to have arrived when a universal method of nomenclature should be adopted, and M. G. Bigourdan, in the *Comptes rendus* (No. 26, June 29, 1914, p. 251), discusses the whole question from this point of view. He reviews the systems of W. Herschel, J. Herschel, Schultz, Kobold, Wirtz, Max Wolf, Bailey, etc., and finally submits a scheme which while embodying the chief points and notations of previous classifications appears to be simple, brief, and comprehensive. This scheme should serve as a good basis for discussion, and, even if modified, M. Bigourdan will have done a good service by bringing this subject of classification to a head.

WATTS'S "INDEX OF SPECTRA."—The "Index of Spectra" by Dr. W. Marshall Watts is a publication familiar to all spectroscopists, and completes and brings up to date in the forms of appendices the wave-length determinations of the elements. Appendix W, the second of a new series, has just made its appearance, and contains the spectra of chromium, cobalt, copper, dysprosium, erbium, europium, and fluorine, concluding with additions and corrections to Appendix V.

THE NAPIER TERCENTENARY.

THE Napier tercentenary celebration, to be held in Edinburgh under the auspices of the Royal Society of Edinburgh, will open formally on the afternoon of Friday, July 24, when the Right Hon. Lord Moulton will deliver the inaugural address. The same evening the Lord Provost and magistrates will give a reception in honour of the event. On the afternoon of Saturday, the governors of Merchiston Castle School will entertain the members of the congress, who will thus have an opportunity of seeing the very room which John Napier occupied as his study. The divine service in St. Giles' Cathedral on the afternoon of July 26, and the farewell reception given by the president and council of the Royal Society of Edinburgh, form the remaining gatherings of a general nature.

The other meetings will be essentially mathematical in character, and will be held on Saturday forenoon and on the greater part of Monday, in the University, the rooms of the mathematical department, and a number of other rooms and halls in the immediate vicinity being utilised for the purpose.

The general arrangement of the programme is to devote Saturday forenoon to papers and discussions of an historical character. Dr. Glaisher, F.R.S., Prof. Cajori, Prof. Eugene Smith, and others are expected to take part.

On the Monday the communications will refer mainly to the construction of mathematical tables and the methods of calculation. Prof. Andoyer, of Paris, Prof. Bauschinger, of Strassburg, Prof. d'Ocagne, of Paris, and M. Albert Quiquet, the secretary of the Actuarial Society of France, have all agreed to read papers on the subjects with which their names are identified, and well-known representatives from America and the United Kingdom will also be among the speakers.

Some points of practical interest have been suggested for discussion, *e.g.* a facsimile reprint of the original edition of the "Descriptio," the construction of a table of co-logs to seven figures, the publication of part of Dr. Sang's great volumes of manuscript tables of logarithms and sines.

A particularly interesting feature of the congress will be the exhibits of books, instruments, calculating machines, Napier relics, etc. These are to be arranged in the large examination hall of the University, close to the mathematical department. From Lord Napier and Ettrick and other representatives of the Napier family some interesting portraits and other relics have been received; and Mr. Lewis Evans's remarkable collection of "Napier's Bones," or "Numbering Rods," will form a valuable exhibit in itself. Mr. J. R. Findlay has set out a large selection of portable sundials dating from the sixteenth century. John Napier's own works and the other early editions of logarithmic tables published both in Great Britain and the Continent will be of great interest to all mathematical students. Mr. Roberts has undertaken to set up his tide-predicting machine, and have it in action during the time of the Napier Congress and the succeeding mathematical colloquium. Slide-rules, arithmometers, integraphs, and many other forms of calculating machine, will be of special interest to the practical calculator.

These and many other exhibits are being described in an illustrated handbook which every member of the congress will receive with his membership card.

It is expected that the exhibition will be open to members on Thursday, July 23, or on Friday morning at the latest, so that there will be ample time to view it before the meetings begin.

All members of the congress will have the privilege of using the rooms of the Royal Society of Edinburgh. They will also be elected honorary members, for the time being, of the Edinburgh University Students' Union, where luncheon and other club privileges may be enjoyed.

It should be mentioned in conclusion that the Napier tercentenary celebration has received a remarkable degree of support from individuals and from educational institutions over the whole civilised world. In virtue of this support, the committee has felt justified in preparing beforehand for distribution a handbook full of mathematical lore. In the memorial volume valuable communications will be published, and the salient features of the congress will be recorded.

To all who have thus aided in making the tercentenary celebration of the publication of the first book of logarithms a real success, I wish now to convey the cordial thanks of the general committee of the Napier celebration, and of the council of the Royal Society of Edinburgh, among whom the project first took shape.

C. G. KNOTT.

THE ROYAL SANITARY INSTITUTE CONGRESS AT BLACKPOOL.

THE twenty-ninth Congress of the Royal Sanitary Institute, held at Blackpool on July 6–11, was well attended, and the addresses, papers, and discussions were well above the average in interest and importance.

Lord Derby, who opened the congress on the Monday, pleaded for greater attention being given to physical and military drill as an aid to hygiene, basing his argument upon the improved physique of the Army, as compared with that of the classes from which they were drawn.

A paper upon the action of some metals upon certain water and other bacteria, presented by Prof. Delepine and Dr. A. Greenwood, gave an account of the recent results of the investigation of the above subject, carried on in the pathology and public health laboratory of the University of Manchester. The detailed results are contained in a series of tables printed in the original paper, and are summarised in the conclusions at which the authors arrive, as follows:—

Pure platinum, gold, and tin, which do not seem to be appreciably acted upon by water, or by the organic media used in the experiments, did not appear to have any action on the four kinds of bacteria experimented upon.

Lead, aluminium, and iron, which were distinctly acted upon, were either without appreciable effect (lead), or had only a slight inhibitory action (aluminium and iron).

Copper, silver, zinc, and mercury had a powerful inhibitory action, and also showed evidence of being acted upon by the media, and of forming certain compounds the nature of which will be discussed elsewhere. In all cases where a marked inhibitory action was produced it was noticed that in reduced doses the metals were also capable of an excitatory action which resulted in increased growth of bacteria.

It will be noticed that all bacteria were not affected in the same way and to the same extent. The action of soft water upon copper and upon lead is very rapid; but while the passage of lead into the water does not appear to affect the bacterial contents, that of copper is attended with complete, or almost complete, sterilisation in about half an hour.

Dr. J. W. Brittlebank, veterinary officer to the Sanitary Committee of the Manchester City Corporation, delivered an address to the Veterinary Section of the congress, in which he dealt chiefly with the milk supply and the provisions of the new Milk Bill, now before the House of Commons. His own views are summed up in the following paragraphs:—

"Public attention has been directed for many years past to the question of the milk supply, and there is little doubt that considerable progress and improvement has been made in the general conditions; but there is, I am afraid, a constant danger of allowing ourselves, when considering the question, to drift into one of its side-issues, namely, the elimination of tuberculous milk. Doubtless this is a most important question, perhaps the most important aspect, but in considering this we are apt to forget the other branches of the problem.

"Our aim should be to put within the reach of everybody a supply of good, clean, disease-free raw milk, which may be consumed in any quantity with safety. It is perfectly true that many are so unfortunately situated, as to be able to purchase only the most meagre amounts, but they have just as much right to protection as their more fortunate brethren.

"The whole question teems with difficulties, and requires great qualities of statesmanship in its handling. The business aspects of the question are important, inasmuch as the price of the article to the consumer is of paramount importance. Certain it is that improvement in conditions cannot be obtained without enhancing the value of the article produced, and it behoves all concerned to restrict the requirements asked for, within such limits as may be regarded to be the minimum of safety."

In the Preventive Medicine Section, Dr. Arthur Sellers, lecturer on comparative pathology in the University of Manchester, read a paper on the blood changes in lead workers, giving the results of investigations carried on in the public health laboratory of that University. The chief object of this investigation was to obtain some first-hand information concerning the blood changes in workers in lead, especially as regards the significance of the presence of basophile granules in the red corpuscles (the "erythrocytes ponctués" of French writers), and the conditions under which they occur.

The men examined were all adult males. Most of them were employed at the works of the Chloride Electrical Storage Co. at Clifton Junction, in various ways involving contact with lead. Three men were undoubted cases of lead-poisoning, not employed by the Chloride Company, but sent to the works to obtain bath treatment.

The conclusions arrived at were as follows:—

(1) The presence of basophile granules in the blood of lead workers affords very strong evidence of lead absorption, but in itself is no absolute proof of lead poisoning. It would appear wrong to exclude such cases from following their ordinary work, but they should be regarded as a special class, and kept under close observation. The knowledge of the existence of such cases in a factory would certainly facilitate the work of inspection.

(2) Blood examinations are of great value in cases where the clinical symptoms are doubtful, and in cases of suspected malingering or imaginary illness. In such cases a positive finding would at all events go to show that lead absorption had occurred. A negative result is of less significance, though it has a certain value.

Dr. S. Rideal, of London, in a paper read before the Domestic Hygiene Section of the congress, discussed the use of paper utensils in the home as a substitute for glass and china or earthenware. The argument for the use of paper plates, cups and saucers, which can be destroyed after use, was based chiefly on the fact that recent scientific investigation has proved that cups taken from schools, stores, and hotels have been found infected with several pathogenic forms of bacteria (including those of diphtheria, pneumonia, and influenza), even when supposed to be clean and ready for use. At one of the largest hospitals there is a regulation that all crockery, cutlery, glass, etc., should be rinsed in a disinfectant before being used again. In these days of typhoid and diphtheria "carriers," the public are entitled to expect the adoption of similar precautions in places of refreshment; but this, of course, involves expense and labour.

Samples of the following articles, made in paper, were exhibited at the close of the address, which aroused much interest and a keen discussion:—*Cups:* automatic dispenser; collapsing. Plates, table-covers; handkerchiefs; towels (various); blind; spitting-cup; formaldehyde generator (home-made). *Bags:* coke bag; moth bag; bags for cookery.

PALISSY AS A PIONEER OF SCIENTIFIC METHOD.

EVERYONE is familiar with the dramatic story of Bernard Palissy, the potter, and how he fired a kiln with his household furniture in order to produce sufficient heat to melt his glazes, but his scientific work is rarely mentioned. A paper on "Palissy, Bacon, and the Revival of Natural Science," by Sir T. Clifford Allbutt, published in the Proceedings of the British Academy (vol. vi.) is therefore a welcome contribution to the history of science.

Palissy shares with Galileo and Gilbert the credit of being a pioneer of modern scientific method. Born in 1519, in Périgord, he was apprenticed to the art of glass painting, and in 1539 saw the cup of glazed faïence which inspired him to produce a similar glaze upon ware. After he had succeeded, he found his way to Paris, where he wrote books on many scientific subjects; and during the years 1575–84 he exercised great influence upon society in the city. He lectured on agriculture, chemistry, mineralogy, and geology, and illustrated his lectures with demonstrations of natural objects from his museum. "Into the faces of the learned of his time he thrust his facts; he urged the might of the verified fact, the tests of practical experience, the demonstration of the senses; and these in a keen and original way." Among the physicians who attended his lectures was no less a person than Ambrose Paré.

By observation and experiment Palissy combated the prevailing notion that springs originated in the percolation of sea-water into the earth; and he showed that they were formed at the junction of permeable and impermeable strata. He collected fossils widely and understood their nature; and both Buffon and Réaumur bore testimony to the correctness of his judgments upon this and other geological subjects. At the age of eighty Palissy was thrown into the Bastille as a dangerous heretic, and he died there after enduring about a year's imprisonment.

Sir Clifford Allbutt suggests that Francis Bacon, who went to Paris in 1576, and resided there for three years, must have been influenced by Palissy's Museum or lectures, though no mention of them is found in any existing work. "What is certain is that Palissy was then teaching practically the methods which a few years afterwards Bacon propounded at length; and not only so, but was teaching them, if with a far inferior literary capacity, yet with a sounder grasp of their methods."

Bacon constructed an imposing philosophical system of rules by which natural facts and phenomena were to be studied, but it was Palissy, Gilbert, and Galileo who were the real founders of the experimental method of inquiry upon which the superstructure of modern science has been built.

EXPLOSIVES.[1]

AN explosive is a body which, under the influence of heat or shock, or both, is, speaking popularly, instantaneously resolved entirely, or almost so, into gases.

Practical explosives consist either of bodies such as nitroglycerine and nitrocellulose, which are explosive in themselves, or mixtures of ingredients which separately are, or may be, non-explosive, but when intimately mixed are capable of being exploded.

Explosives are exploded either by simple ignition, as in the case of black gunpowder, or by means of a detonator containing mercury fulminate.

The molecules of an explosive may be regarded as in a state of unstable chemical equilibrium. A stable state of equilibrium is brought about by the sudden decomposition of the original compounds with the evolution of heat. An explosion is thus an extremely rapid decomposition, accompanied by the production of a large volume of gas and the development of much heat.

There are two well-defined modes of explosion which can be described as combustion and detonation. In the former case, the explosive is simply ignited and combustion takes place by transference of heat from layer to layer of the explosive. The rapidity with which the combustion proceeds depends not only on the physical form of the explosive, but also on the pressure under which the decomposition takes place. When in the form of fine grains, combustion pro-

[1] From a course of lectures delivered before the Institute of Chemistry, at King's College, London, by Mr. William Macnab, and published by the Institute

ceeds much more quickly than when the grains are large, and the powder maker takes advantage of this fact in preparing powder for rifles and the various sized large guns.

Detonation, on the other hand, has to be started by a sufficiently strong impulse, such as the explosion of a charge of mercury fulminate; it proceeds much more rapidly and is due to the formation of an explosion

oxidation, the products are carbon dioxide, carbon monoxide, hydrogen, water, and nitrogen, but the relative proportions vary with the pressure developed. When such an explosive is fired in a closed vessel under different densities of charge, that is, different quantities of explosive in the same volume, the volume and composition of the gas varies with the pressure developed by the explosion. The carbon dioxide and

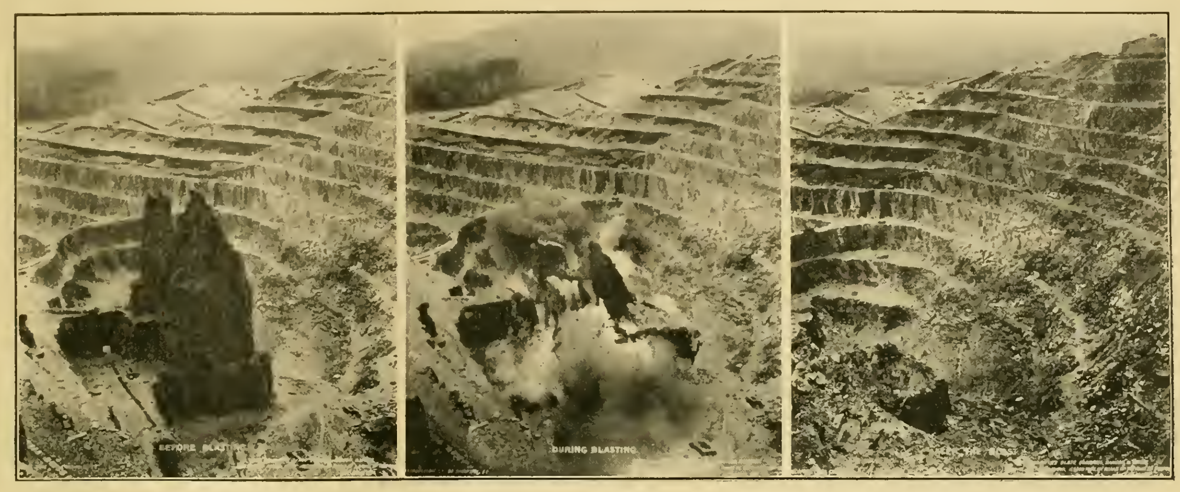


FIG. 1.—Blast at Lord Penrhyn's slate quarries.

wave that has a velocity of thousands of metres a second.

Black gunpowder and allied explosives, as well as the smokeless powders, belong to the first or combustion class, and they are commonly designated "low" explosives.

"High" explosives indicate those, such as dynamites and nitrate of ammonia explosives, which detonate

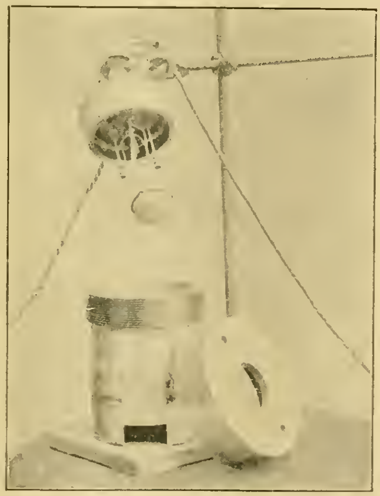


FIG. 2.—Berthelot calori-metric bomb.

and have a greater shattering action than the former.

The volume and composition of the gas produced, both in regard to the power of the explosive, and, in the case of mining explosives, the health of the miner, are of great importance. These gases are largely determined by the original composition of the explosive.

When there is insufficient oxygen for complete

hydrogen increase and the carbon monoxide and water diminish as the pressure increases; also, at high pressures, considerable amounts of methane are formed. In the foregoing, it has been assumed that complete explosive decomposition has taken place.

When a high explosive burns, instead of explodes, the chemical changes are not only very much slower and the disruptive effect practically *nil*, but the char-

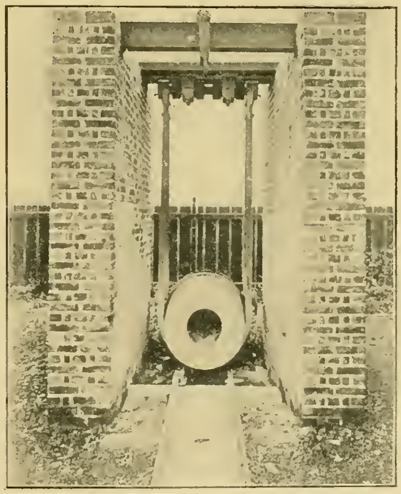


FIG. 3.—Ballistic pendulum, Home Office testing station.

acter of the gases is entirely changed, large volumes of poisonous nitrous fumes along with other gases being produced.

The temperature developed by an explosive is of importance, because the higher the temperature the greater the erosion of the guns.

Nearly all blasting explosives, except black powder, are fired by means of a detonator. Fulminate of mercury is the most widely employed constituent of the detonator charge; sometimes it is used alone, but more usually with an admixture of 20 per cent. of potassium chlorate.

Trinitrotoluene, picric acid, and tetranitromethylaniline, each with a small quantity of fulminate as primer, have also been used for charging detonators.

More recently lead azide prepared from the sodium salt of hydrazoic acid N_3H, by means of a lead salt, has also been used, as it has a greater power of initiating detonation, so that less azide is required to detonate an organic explosive than would be required of fulminate. Its manufacture, however, is more delicate than fulminate, and the formation of large crystals must be avoided, as they have the unpleasant property of sometimes exploding spontaneously.

Another new explosive body which appears likely to play an important part as a charge for detonators is tetranitroaniline, manufactured by nitrating metanitroaniline. It combines an exceptional explosive power with aromatic stability and has a high density.

It can be easily detonated, even when highly compressed, and has such a high percentage of oxygen that it can be detonated without residue or smoke.

In blasting operations, gunpowder and detonators are either fired by a time fuse or electrically. The time fuse consists of a thin but continuous core of black powder covered by a case of twine and tape and varnish. It is made to burn at a known uniform rate, generally 2 ft. a minute, in order that a sufficient length can be used to allow the shot-firer, after lighting the fuse, to reach shelter before the explosion takes place.

The instantaneous fuse, which burns at the rate of 100–300 ft. a second, affords a mean of firing many charges simultaneously.

Occasionally it happens that a coil is defective, generally through discontinuity in the powder core. C. Napier Hake, late Chief Inspector of Explosives for Victoria, ingeniously employed X-ray photography to examine suspected coils, and, in this way, was able to recognise those which were defective.

One of the most interesting recent productions is the "detonating fuse," a soft metal tube filled with trinitrotoluene which detonates with greater velocity than most explosives. When placed alongside the cartridges in a deep borehole, it is considered to give an enhanced blasting effect by causing the whole charge to go off more simultaneously than when the column of explosive is fired at one end by a detonator in the usual way.

With the object of preventing accidents so far as possible, and minimising the loss of life should an explosion occur, a number of rules and regulations have been drawn up by the Explosives Department of the Home Office which have to be followed in the construction and working of explosive factories.

The object of the restrictions is to allow only limited quantities of explosive material and a limited number of workpeople in one building at a time, and, further, to place the different buildings at such distances from each other, or surround them by protecting earth mounds, that in the event of an explosion the effect is localised as much as possible and the explosives in the adjacent buildings are not "set-off."

The manufacture of guncotton and the other forms of nitrocellulose is carried out in the first stages in the non-danger part of the factory.

The most interesting development of the nitration process is the method devised by J. and W. Thomson, of the Royal Gunpowder Factory, Waltham Abbey.

The composition of the acid mixture is of the greatest importance and largely determines the character of the product. The ratio between the nitric and sulphuric acids and the water must be accurately adjusted.

It must also be remembered that the cotton is by no means a definite chemical body, and its physical state plays an important part. Samples of different cottons, under the same conditions in a bath of the same composition, while yielding nitrocelluloses containing practically the same percentage of nitrogen, may vary in solubility in ether-alcohol from 25 per cent. to 70 per cent.

Turning now to the production of nitroglycerine, this manufacture is much simpler than that of nitrocellulose; at the same time, it is much more dangerous.

The plant which is at present most employed is known as the nitrator-separator. It was developed at Waltham Abbey by Sir Frederic Nathan and W. Rintoul, and is a great advance on the former methods.

The nitrator-separator is a cylindrical leaden vessel with a coned top; inside are placed leaden coils, through which cooling water circulates, and pipes, through which compressed air is blown to mix the contents. The glycerine is introduced in the form of a fine spray under the acid by means of a special injector, worked also by compressed air.

When everything goes right, the nitration of the charge is usually completed in about one hour; the agitation with the air is discontinued and the separation of the nitroglycerine from the acids takes place—being lighter it comes to the top. A pipe, in which a glass window is fitted, leads from the top of the nitrator-separator to a pre-washing tank; by allowing waste acid from a previous operation to enter at the bottom, the nitroglycerine is forced over into the washing tank; and the flow of acid is stopped whenever all the nitroglycerine has passed into the washing tank, which can be observed through the window.

FIG. 4.—"Mounded" house, Cotton Powder works.

With the object of preventing explosions of gas or coal-dust in mines, our Government, in common with many others, has instituted a test which explosives have to pass before they are put on the "permitted" list, and are available for use in fiery or dusty mines. This test has varied in the different countries, and a change has been introduced recently, since the transference of the testing station from Woolwich to Rotherham. Much difference of opinion still exists as to the best means of carrying out such a test.

One of the chief factors in determining the ignition is the temperature developed by the gases of explosion. Owing to lack of data, the temperature cannot be calculated with sufficient accuracy, and other conditions obtain which make a practical test more helpful. Nevertheless, the temperature is of great importance and many means are employed of lowering it, such as adding salts which absorb heat on volatilisation.

The rapidity of detonation, the length of the flame, and the heat evolved, all influence the readiness with which explosives ignite gas or coal-dust; but in this connection knowledge and progress have been chiefly promoted by direct experiment at the various testing stations here and abroad.

The filling material for shells has been the subject of much experiment and trial by the different countries. Picric acid, under the various names of melinite, lyddite, shimose powder, etc., has been extensively tried and found wanting. Ammonal, containing ammonium nitrate, with a large percentage of trinitrotoluol and finely divided aluminium, is a very safe and powerful explosive, and has been adopted as the charge for shells by the Austrian Government. It has the disadvantage of containing the hygroscopic ammonium nitrate as an ingredient, and must consequently be specially protected against moisture. At present, trinitrotoluol is the body which has commended itself to most of the Governments as the best bursting charge for shells, torpedoes, and general military blasting work, and has just been adopted by our own Government.

Experience in America, South Africa, and Australia has shown that the fruit-grower has a real friend in explosives, and it seems to me that, in this country also, we must wake up to this beneficent aspect of explosives and the means they offer of attaining results otherwise impossible.

In the case of tree planting, it is not the mere comparison of the cost of the excavation of the hole in which to place the tree which has to be considered. When an explosive is employed, the soil is shaken up and fissured for a comparatively wide area beyond the hole actually required for the tree. When, as often happens, there is a hard and impervious subsoil beyond reach of the spade, this is also opened and fissured, and experience has shown that trees planted in ground prepared by explosives make a much more vigorous and rapid growth than when planted in the ordinary way. Some trees have begun bearing after four years, while others similarly situated but spade planted did not yield fruit until six years.

In the case of existing orchards little can be done in the ordinary way to aerate or render the soil more pervious to the roots and moisture, but a small cartridge inserted at some depth below the tree, or a larger one exploded at a depth of 3 ft. or so below the surface and midway between trees planted about 15 ft. apart, has a most beneficial effect in loosening the soil without injuring the trees. The roots have less resistance to overcome, the soil is aerated, the moisture retaining properties improved, and a new lease of life is thus given to an old orchard; the trees become more vigorous and productive, and indeed are rejuvenated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The following appointments have been made:—Mr. Howard Priestman to be lecturer in textile industries; Dr. A. M. Pryce to be demonstrator in bacteriology; Dr. H. E. Woodman to be research assistant in animal nutrition; Mr. H. A. Wyllie to be additional assistant lecturer and demonstrator in agriculture.

The second annual Yorkshire Summer School of Geography will be held at Whitby on August 3–22. The work of organisation has again been undertaken by the University of Leeds, and the director of the school will be Prof. Kendall. The special subject this year will be the British Isles, treated in a general course, dealing with land forms and structure, meteorology and economic geography. There will be alternative courses at the choice of each student on (1) agriculture, rocks and soils, and (2) oceanography, rivers and river development, and the evolution of transport. As in last year's course, special attention will be paid to practical and field work.

LONDON.—The council of Bedford College has made the following appointments:—Assistant-lecturer in mathematics, Mr. C. Clemmow; demonstrators in physiology, Miss G. Hartwell and Miss N. Tweedy; demonstrators in chemistry, Miss E. Field and Miss B. M. Paterson; demonstrator in geology, Miss I. Lowe.

DR. F. R. MILLER, of the department of physiology, McGill University, Montreal, has been appointed professor of physiology in the Western University, London, Canada.

THE distribution of prizes at the Horticultural College, Swanley, Kent, will be held on July 23. The prizes will be presented by Lady Reid, and Sir George Reid, G.C.M.G., High Commissioner for Australia, will give an address. The chair will be taken at 4 p.m. by Sir John Cockburn, K.C.M.G.

THE governors of the Imperial College of Science and Technology have appointed Dr. A. N. Whitehead, F.R.S., to the newly constituted chair of applied mathematics, and Dr. C. G. Cullis to the professorship of economic mineralogy. These changes form part of the general scheme of development of the Imperial College "for the provision of the fullest equipment for the most advanced training and research in various branches of science, especially in its application to industry."

THREE issues of the *Undergraduate*, the University of London magazine, published by the Students' Representative Council, have been received. The first issue announced in December last that four numbers of the magazine would be published during the current session, and gave the last day for receiving contributions for the next issue as "19th January, 1914." Yet the second number bears the date May, 1914, and it says nothing of the number of issues during the session. The third issue is dated July, 1914. Sir Henry Miers writes in the December issue:—"A magazine which will represent the University as a whole, and will give to all its members a medium of free expression upon the numerous and increasing matters of University interest will . . . satisfy a very real need." We trust that the magazine will meet with the success to which the variety and interest of its contents entitle it.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 25.—Sir William Crookes, president, in the chair.—Sir W. **Crookes**: The spectrum of elementary silicon. The author has tried in vain for years to get pieces of fused silicon in an approximate degree of purity. Lately the Carborundum Co. at Niagara Falls sent him three samples giving an analysis of 99·56, 99·86, and 99·98 per cent.

of silicon, the impurities being titanium, iron, and aluminium. This material has been used in the present research. The paper gives a complete list of silicon lines from λ 2124·163 in the ultra-violet to λ 6371·032 in the extreme red, with some remarks referring to missing or doubtful lines.—Prof. S. P. **Thompson**: Note on Mr. Mallock's observations on intermittent vision. In his paper of December, 1913, on intermittent vision, Mr. Mallock discussed the phenomena observed when a rotating disc of twelve black sectors painted on a white ground is viewed while a slight mechanical shock is given to the body or head. He concluded that a mechanical acceleration imparted thus to the nerve structures on which vision depends produces a momentary periodic paralysis. The author, repeating Mr. Mallock's experiments, finds that effects of precisely the same kind appear when, on viewing the rotating sector disc in a mirror mounted elastically on a support, slight mechanical shocks are given to the mirror instead of to the observer. He therefore attributes the effects, both in Mr. Mallock's original experiments and in his own, to momentary minute displacements of the image on the retina, stimulating rods and cones which are relatively unfatigued and which therefore are momentarily of greater sensitiveness.—T. R. **Merton**: Attempts to produce rare gases by electric discharge. An investigation has been made of the apparent production of neon and helium by electric discharges in vacuum tubes. An apparatus has been designed in which protection from atmospheric contamination can be secured by a mercury seal throughout the experiment. It has been found that the presence of argon in the residual gases furnishes an exceedingly sensitive test for atmospheric contamination, and that a mercury seal can only be relied on if precautions are taken to ensure that the mercury and glass are scrupulously clean. The author has not been successful in reproducing the conditions necessary for the production of neon and helium.—A. C. G. **Egerton**: The analysis of gases after passage of electric discharges.—C. T. **Heycock** and F. H. **Neville**: Dilute solutions of aluminium in gold.—Prof. F. G. **Donnan** and G. M. **Green**: The variation of electrical potential across a semipermeable membrane.—J. H. **Jeans**: The potential of ellipsoidal bodies and the figures of equilibrium of rotating liquid masses. Sir G. Darwin was convinced that the pear-shaped series of figures of equilibrium discovered by Poincaré was initially stable, while M. Liapounoff had with equal conviction announced that it was unstable. The present investigation was undertaken primarily in the hope of deciding between these two views. The main conclusion arrived at is somewhat disappointing. It is that, in spite of the labours of Poincaré, Darwin, and Liapounoff, we have still no definite knowledge as to the stability or instability of the pear-shaped figure. All these investigators have worked at the question of the stability of the pear-shaped figure carried so far as the second order of small quantities. The present paper indicates that, so far as second-order terms, there is a doubly-infinite series of such figures which can, of course, be broken up into linear series in as many ways as we please. So far as can be seen, Sir G. Darwin has concerned himself with only one of these series, while M. Liapounoff has presumably dealt with a different series. It appears that the true linear series demanded by the general theory of Poincaré (*Act. Math.*, vii., p. 259) only reveals itself when the computations are carried so far as the *third* order of small quantities, a conclusion which is confirmed by the result of a previous investigation on the figures of equilibrium of rotating cylinders (Phil. Trans., A. 200 (1902), p. 67).—Dr. C. **Chree**: The 27-day period in magnetic phenomena. The author has dealt in two previous papers in the Philosophical Transactions with data which seemed to confirm the reality of a period of about 27 days in magnetic phenomena, in the sense that if any particular day is more than ordinarily disturbed, or more than ordinarily quiet, the day which is 27 days later shows a decided bent in the same direction. In these investigations use was made almost entirely of magnetic "character" figures. As international "character" figures do not exist for years prior to 1906, and as "character" figures assigned at one station are open to certain objections, it appeared desirable to ascertain whether or not the 27-day period is clearly shown in the average year by the amplitude of the daily ranges of the magnetic elements. This is investigated in the present paper, use being made of the Kew declination horizontal force and vertical force ranges from 1890 to 1900, treated independently. The period is found to be clearly shown by the range of each element.—J. J. **Nolan**: Electrification of water by splashing and spraying. Water is broken into fine drops—(1) by allowing it to fall into a horizontal air stream of high velocity; (2) by spraying. The size of the drops and the charge per c.c. of water are measured. The conditions of the experiments enabled measurements to be made for drops of different sizes. It is found that the charge is positive and inversely proportional to the radius of the drops. This result follows if we assume that there is a constant charge produced per unit area of new water surface formed. The value of this constant is approximately $2{\cdot}7 \times 10^{-3}$ electrostatic units for distilled water, the splashing and spraying methods giving identical results.—W. G. **Duffield**: Effect of pressure upon arc spectra. No. 5.—A. **Campbell** and D. W. **Dye**: The measurement of alternating electric currents of high frequency. As the accurate measurement of currents larger than 1 ampere at high frequencies presents considerable difficulty, the authors have investigated the accuracy obtainable in the use of air-core current transformers (suggested by Mr. T. L. Eckersley). It is found that, with proper design, such transformers allow of the measurement of currents up to 50 amperes or higher, at frequencies from 50,000 up to 2,000,000 per second, with an accuracy of 1 or 2 parts in 1,000. Over the same range of frequency it is also found that iron-cored transformers can easily be designed so as to give very accurate results.—Sir D. **Bruce**, Maj. A. E. **Hamerton**, Capt. D. P. **Watson**, and Lady **Bruce**: (1) The trypanosome causing disease in man in Nyasaland. The Liwonde strain. Part i.—Morphology. Part ii.—Susceptibility of animals. (2) The naturally infected dog strain. Part i.—Morphology. (3) Susceptibility of animals to the naturally infected dog strain. (4) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. The human strain. vi.–x. (5) The trypanosome causing disease in man in Nyasaland. ii.—The wild game strain. iii.—The wild *Glossina morsitans* strain. Part ii.—Susceptibility of animals. (6) The naturally infected dog strain. Part iii.—Development in *Glossina morsitans*. (7) The naturally infected dog strain. Part iv.—Experiments on immunity.—Dr. F. **Horton**: The origin of the electron emission from glowing solids.—W. A. D. **Rudge**: Some sources of disturbance of the normal atmospheric potential gradient.—Prof. J. **Joly**: A theory of the nature of cancers and of their treatment by radio-therapy.—C. S. **Mummery**: Morphological studies of benzene derivatives. VI.—Parasulphonic derivatives of chloro-, bromo-, iodo-, and cyano-benzene.—F. H. **Newman**: Absorption of gases in the discharge tube.—Miss M. P. **FitzGerald**: Further observations on the changes in the breathing and the blood at various high altitudes.—W. E. **Agar**: Experiments on inheritance in parthenogenesis.—C. S. **Myers**: The influence of timbre and loudness on the localisation of sounds.—S. J. **Kalandyk**: (1) The conductivity of salt vapours. (2) The ionisation produced by gas reactions. The experiments described in (1) show:—1. The conductivity of the salt vapours is due to the processes occurring in the vapours themselves. 2. The vapours of carefully dried salts conduct the electric current. Therefore the conductivity cannot be ascribed to the chemical action of water vapour in the salt vapours. However, the presence of water vapour increases the current passing in salt vapours. 3. When cadmium iodide was very carefully dried it was possible to observe a current which was practically independent of time. 4. The connection between the current i and the temperature θ may be expressed with considerable accuracy by the formula $i=ae-b/\theta$ where a and b are constants. 5. The ionising potential calculated from the energy of dissociation is considerably less than for the ordinary gases. 7. The dissociation of vapours is not always accompanied by ionisation.—H. **Richardson**: The excitation of γ-rays by β-rays.—F. E. E. **Lamplough** and J. T. **Scott**: The growth of metallic eutectics.—W. E. **Curtis**: Wave-lengths of hydrogen lines and determination of the series constant. (1) The wave-lengths in I.A. of the first six lines of the hydrogen series have been determined with an accuracy of 0·001 A.U. (2) Balmer's formula has been found to be inexact. The results may be represented by a modified Rydberg formula containing only two constants, thus:—

$$n=\frac{N}{4}-\frac{N}{(m+\mu)^2}$$

where

$$N=109,679\cdot22$$

and

$$\mu=+0\cdot0_5 69.$$

(3) An accuracy of 0·001 A.U. is attainable in the third order of a 10-foot concave grating if the exposures are short (say less than half-an-hour). With longer exposures accurate determinations become very difficult if the temperature of the instrument cannot be controlled. (4) The tertiary iron arc standards determined by Burns were tested in the special regions under investigation, and found very satisfactory.—A. **Compton**: Constancy of the optimum temperature of an enzyme under varying concentrations of substrate and of enzyme.—Dr. E. H. **Griffiths** and Ezer **Griffiths**: The capacity for heat of metals at low temperatures. An account is given of an investigation into the capacity for heat of some metals at various points in the range 0° to −160° C. A new method of obtaining constant temperatures is described in which the Joule-Thomson cooling effect on expansion of air is utilised. The formulæ of Einstein, Nernst and Lindemann, and Debye are compared with the experimental results over a very extended range of temperature. None of the formulæ, however, can be regarded as completely representing the experimental results.—T. **Lewis**, J. **Meakins**, and P. D. **White**: The excitatory process in the dog's auricle.—Dr. P. J. **Cammidge** and H. A. H. **Howard**: (1) Observations on the composition and derivatives of urinary dextrin. (2) The so-called lævulose met with in urine. Communicated by Dr. A. E. Garrod.—T. M. **Lowry**: The silver voltameter. Part iii.—The solvent properties of silver nitrate solutions.—A. **Mallock**: Fog signals.—Areas of silence and greatest range of sound.—W. R. **Bousfield**: The osmotic data in relation to progressive hydration.—Dr. S. **Chapman**: The lunar diurnal variation of the earth's magnetism at Pavlovsk and Pola (1897–1903).—W. **Barlow**: The interpretation of the indications of atomic structure presented by crystals when interposed in the path of X-rays.—Prof. J. C. **McClennan**: The fluorescence of iodine vapour excited by ultra-violet light.—A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility. Part iii.—On the molecular field in dia-magnetic substances.—A. **Holt**: Diffusion of hydrogen through palladium.

Physical Society, June 20.—Sir J. J. Thomson, president, in the chair.—Sir J. J. **Thomson**: Production of very soft Röntgen radiation by the impact of positive and slow kathode rays. Röntgen and his pupils held that light waves are identical in nature with electrical waves produced by mechanical means, but there is a gap between the longest infra-red radiation and the shortest electrical wave that can be produced mechanically. The work already done on X-rays has demonstrated the existence of two separate rings of electrons in the atom, one within the other. These rings are responsible for the K and L types of radiation respectively. The L radiation is so much softer than the K that if a third ring of electrons exists, the radiation from which is proportionately softer than that of the L type, this radiation will fall well within the gap. In an experiment described a special form of discharge tube was employed. The positive rays passed through a tubular perforation in the kathode and impinged obliquely on a metal target. A photographic plate of the Schumann type was situated at the further end of a branch tube so that no solid obstacle interposed between the target and the plate. When the discharge passed the photographic plate was affected. An intense transverse electrostatic field between two metal plates situated between the kathode and the target completely stopped the effect, showing that this was not due to stray radiation *reflected* from the target. Hence the passage of positive particles from the kathode to the target was essential. A strong transverse electrostatic field in the branch tube had no effect, showing that a radiation was passing between the target and the plate, which was not, therefore, merely affected by positive particles rebounding down the side tube after impact on the target. The properties of this radiation were intermediate between ordinary X-rays and Schumann waves. They were susceptible to reflection by metal surfaces, and their penetrating power was small. They were stopped by the finest collodion film obtainable. The quality of the radiation did not depend on the energy of the moving particles which gave rise to it, but on the velocity. Hence equally soft rays should be produced by kathode particles if these were travelling as slowly as the positive rays. The velocity of impact was varied over a large range, and radiations were obtained varying in quality from hard X-rays to the so-called Schumann waves. It is hoped by the study of these radiations to determine not only the number of rings of electrons within the atom, but the number of electrons in each ring.—F. W. **Aston**: The homogeneity of atmospheric neon.

June 26.—Dr. A. Russell, vice-president, in the chair.—Prof. J. A. **Fleming**: Atmospheric refraction and its bearing on the transmission of electromagnetic waves round the earth's surface. The conditions under which true atmospheric refraction would be sufficient to carry a ray of light or electromagnetic radiation sent out horizontally from any point on the earth's surface round the earth parallel to its surface are considered. Pure diffraction is insufficient to account for all the phenomena of long-distance wireless telegraphy, but some action of the atmosphere which tends to curve the radiation round the earth has to be postulated. The theory of ionic refraction, based on the theoretical conclusion that in ionised air the velocity of long electric waves is increased, has been put forward. The atmosphere decreases in density as we rise, and this alone produces a decrease of refractive index and an increase in velocity. Formulæ are deduced expressing the variation of density with heights taking into account the known temperature variation with increase of height. At a height of 100 km. the terrestrial atmosphere must consist substantially of hydrogen and helium. An expression is obtained for the radius of curvature at any point of a ray of light sent out horizontally from the earth's surface. This radius at the starting point is given by $\rho=\mu_0(98Aq_0^2)$, where μ_0 and q_0 are the refractive index and density at the surface, and A is the Gladstone and Dale constant for the gas which forms the atmosphere. For air ρ is four times the earth's radius, for hydrogen 136 times, and for krypton equal to the earth's radius. If the terrestrial atmosphere consisted wholly of krypton a ray sent out horizontally would be refracted round the earth, and wireless telegraphy to the Antipodes would be possible. For the same atmospheric density and constant A this circular refraction would result if the earth were twice its present diameter. The suggestion is made that perhaps neon and krypton are manufactured at great atmospheric heights by electric discharges occurring in the rarefied hydrogen atmosphere. Also that by their ease of ionisation they contribute to produce the ionised layer demanded by the theories of Heaviside and Eccles to account for the actual achievements of long-distance wireless telegraphy. Our earth is perhaps unique in being the only planet on which long-distance radio-telegraphy is possible. —G. **Dobson**: Atmospheric electricity observations made at Kew Observatory. Observations were made (1) using the standard Wilson instrument on a stand according to the usual practice, and (2) using an experimental apparatus level with the ground, which was assumed to give correct results. A comparison was made of the electric conductivity of the air as measured by Mr. Wilson's apparatus and that designed by Prof. Ebert.—T. **Barratt**: Thermal and electrical conductivities of some of the rarer metals and alloys. A new method of the "stationary temperature" type is employed for measuring the thermal conductivities of some of the rarer metals, including tantalum, molybdenum, rhodium, iridium, and tungsten, at air temperatures and at 100° C.—F. **Mercer**: Some investigations on the arc as a generator of hgh-frequency oscillations. Experiments on the copper-carbon arc when used as a generator of high-frequency oscillations. The first experiments deal with the effect of varying the arc length, and also the arc current, on the magnitude and frequency of the shunt current. The effect on frequency arises from a change in the resistance of the arc. The second refers to the effect on the shunt current of altering the ratio of inductance to capacity.

PARIS.

Academy of Sciences, July 6.—M. P. Appell in the chair.—Arnaud de **Gramont**: General observations on the ultimate lines of elements from various sources of light. It is pointed out that the strongest lines in the spectrum of a simple body, the "Hauptlinien" of the German physicists, are not identical, the ultimate lines persisting in the condensed spark, and the work of Hartley and Moss is criticised from this point of view. Arranged in decreasing order of temperature the sources of light used were the condensed spark with self-induction, condensed spark without self-induction, non-condensed spark, electric arc, oxy-acetylene blowpipe, oxygen-coal gas flame. Experiments were carried out on forty elements, and a general summary of the results is given.—M. de **Forcrand**: The thermochemical study of some hydrates of manganese sulphate. The values obtained for the hydrates with 2, 3, and 4 H_2O are not in accord with Thomsen's data for the same salts. There would appear to be two isomers of the anhydrous sulphate.—P. **Chofardet**: Observations of the new comet 1914*c* (Neujmin) made at the Observatory of Besançon. Position given for July 4. The comet appeared as a round nebulosity, about 15″ diameter, with a slight central condensation. About 12·5 magnitude.—G. **Beauvais**: The definition of time given by a clock. A study of the clock installed in the cellars of the Paris Observatory, by means of Abraham's photographic chronograph. It was found that a double second might easily be 0·008 sec. too long or too short, with occasional rare deviations amounting to 0·02 sec. The effect of this on the comparison of two pendulums by the method of coincidences and upon the definition of time is discussed. Georges J. **Remoundos**: Series of functions and the singularities of differential equations.—Th. **De Donder** and O. **De Ketelaere**: The electromagnetic field of Maxwell-Lorentz and the gravitation field of Einstein.—Gustave le **Bon**: The principle of relativity and intra-atomic energy.—Léon **Brillouin**: The calorific conductivity and viscosity of monatomic liquids.—C. de **Watteville**: A new method of studying spark spectra. It is known from the work of Hemsalech that when a spark passes between two conductors the initial spark is followed by the production of metallic vapour, and the latter remains luminous for an appreciable time. A new form of apparatus is described which permits of the separation of the luminous effects of the spark and the metallic vapour.—G. **Brañas**: The microradiograph. A description (with diagram) of a new self-recording Morse apparatus for radio-telegraphic signals. With this apparatus installed at Madrid records of messages sent from Paris, Poldhu, and Norddeich have been registered.—H. Kamerlingh **Onnes**: The persistence of electric currents without electromotive force in superconductors. From a study of the resistance of metals at low temperatures attainable with liquid helium it was concluded that the resistance of mercury would be measurable at 4·25°, but would become negligible at 2°. This conclusion has been verified experimentally, but with the unexpected result that the resistance disappears suddenly, for mercury at 4·19°. In a mercury thread at 1·7°, current can be passed with a density of 1000 amperes per sq. mm. without a measurable difference of potential (limit of accuracy $0{\cdot}03\times10^6$ volt) at the extremities, and without developing heat. (See article in NATURE, July 9, p. 481).—H. **Abraham**, A. **Dufour**, and G. **Ferrié**: A method of direct measurement of the time of propagation of the waves of wireless telegraphy on the surface of the globe. The chronographic method ultilised permits of the absolute measurement of a time interval with a precision of 0·00001 sec. The velocity of propagation found for the Hertzian waves between Paris and Washington was 296,000 km. per sec., slightly less than the velocity of light.—M. **Abonnenc**: The influence of tellurium on the sensibility of selenium to light. Carefully purified selenium was mixed with 1, 3, 4, 5, and 7 per cent. of tellurium, and the changes of resistance caused by exposure to light measured. Pure selenium was most sensitive to white light; with red rays the cell with 1 per cent. of tellurium gave the largest change of resistance.—M. **Boulouch**: Systems of dioptres of revolution round the same axis.—L. G. **Stokvis**: The creation of third harmonics in alternators as a result of a want of equilibrium of the phases.—Ruby **Wallach**: The magnetic study of iron oxide. Three forms of precipitated ferric oxide were studied, and the magnetic susceptibility of each determined as a function of the temperature. The results are given graphically.—R. **Portevin**: The velocity of transformation of steels on heating and on the specific electrical resistance of iron.—P. **Chevenard**: The specific volumes of nickel steels.—H. **Guilleminot**: The coefficient of diffusion of the X-rays by substances of low atomic weights, especially organic substances. Some new facts in support of the conclusions given in an earlier paper.—André **Kling**, D. **Florentin**, and P. **Huchet**: Properties of Recoura's green chromium sulphate. For twenty-four hours after their preparation solutions of the green chromium sulphate contain no sulphate ions precipitable by benzidene chlorhydrate; on standing sulphate ions are gradually formed, an equilibrium, depending on the temperature and concentration, being ultimately reached.—L. **Tschugaeff** and W. **Ichlopine**: Some compounds of monovalent nickel. Nickel salts treated with a mixture of sodium hydrosulphite and nitrite give a violet compound, in which the nickel appears to be monovalent, since caustic soda gives a hydroxide NiOH, convertible by sodium sulphide into Ni_2S.—Jacques **Joannis**: The catalytic influence of copper oxide on the combination of oxygen with hydrogen. Iron wire at 300° does not act catalytically on the combination of hydrogen and oxygen, but the two gases react in presence of CuO at the same temperature. The water vapour formed exerts a considerable influence on the catalysis.—A. **Villiers**: Sulphide of manganese and the estimation of this metal. A study of the conditions necessary for the precipitation of the green form of manganese sulphide.—P. **Lebeau** and M. **Picon**: Some hydrogenations by sodammonium: hydrocarbons. With this reducing agent acenaphthene takes up four atoms of hydrogen—anthracene two, phenanthrene four, diphenyl four, and stilbene two. Amylene, benzene, toluene, and cymene, on the other hand, are unaffected.—H. **Gault**: The conversion of oxalacetic ester into α-pyrone derivatives.—R. **Cornubert**: The allyl*cyclo*hexanols, methylallyl*cyclo*hexanols, propyl- and methylpropyl-*cyclo*hexanones, and *cyclo*hexanols.—Henri **Wohlgemuth**: Syntheses by means of the mixed organometallic derivatives of zinc. The γ-chloro-ketones and corresponding products of hydrolysis.—J. **Bougault**: The dioxytriazines.—Léon **Lutaud**: The Senonian of Mazougues (Var).—E. A. **Martel**: The torrential origin of peduncular rocks.—Emile **Belot**: An attempt at the verification of the new physical theory of the formation of oceans and primitive continents.—M. **Cluzet** and Th. **Nogier**: The physical analysis of some springs of Evaux-les-Bains. The water from three springs and the gas from one were examined. Measurements are given of the temperature, density, electrical resistance and radio-activity. The César spring gives a high figure for the radium emanation, 80 millimicrocuries per litre of gas at the spring.—Henri **Lecomte**: The constitution of the seeds of Musa.—H. **Guillemard** and G. **Regnier**: Observations on the physiological action of the climate at high altitudes.—Paul **Godin**: A series of laws of growth based on 2000 observations of children, 300,000 measurements, 1891–1893–1914.—André **Mayer** and Georges **Schaeffer**: Constancy of the concentration in lipoids containing phosphorus of the whole organism; concentration in lipoids in course of growth. Application to biometrics.—Emile F. **Terroine**: Constancy of concentration of whole organisms in fatty acids and cholesterol. Evaluation of the reserves of fats.—Georges **Tanret**: Some physiological properties of the sulphate of galegine. The alkaloid leads to paralysis of the spinal column and nerve centres.—Mme. Marie **Phisalix**: Vaccination against experimental hydrophobia by the cutaneous mucous secretion of Batrachians, followed by snake poison.—E. **Bataillon**: The electrical conductivity of the eggs of virgin Batrachians.—M. **Lécaillon**: The reproduction of *Galerucella luteola*.—Ed. **Sergent** and H. **Foley**: The period of latency of the spirillum in the bug infected with recurrent fever. The virus of recurrent fever, besides the spirillum form, can assume another form, very minute, but equally virulent.—L. **Lindet**: The influence of the mineral content of caseins upon their solubility.—Pierre **Thomas** and Robert C. **Moran**: The proteid substances of *Aspergillus niger*.

New South Wales.

Linnean Society, May 27.—Mr. C. Hedley, vice-president, in the chair.—R. J. **Tillyard**: Some problems concerning the development of the wing-venation of Odonata. As a result of a study of the tracheation of the developing wings of a very large number of dragonfly nymphs, several problems have been elucidated. It is claimed that the Zygoptera are undoubtedly reduced descendants of broader-winged dragonflies. The primary cause of all the peculiarities in Odonate wing-venation is traced back to the change made by an originally land-dwelling larva to fresh water, and the consequent development of a flow of oxygen in the tracheal system from the anal end of the body.—E. W. **Ferguson**: Revision of the Amycterides. Part iii.—Notophes, Amycterus, and genera allied to Talaurinus. A number of the smaller genera are dealt with, partly for convenience, partly because they are mostly related to Talaurinus.

BOOKS RECEIVED.

A First Book of Chemistry. By W. A. Whitton. Pp. vii+150. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

The Pupil's Class-Book of Geography. The British Isles. By E. J. S. Lay. Pp. 118. (London: Macmillan and Co., Ltd.) 6*d*.

Physics of the Household. By Prof. C. J. Lynde. Pp. xi+313. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Farm Woodlot. By E. G. Cheyney and Prof. J. P. Wentling. Pp. xii+343. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Man of Genius. By Dr. H. Türck. Pp. vi+483. (London: A. and C. Black.) 12*s*. 6*d*. net.

Boletin do Museu Goeldi (Museu Paranese) de Historia Natural e Ethnographia. Tome viii., 1911–12. Catalago das Aves Amazonicas. By Dr. E. Snethlage. Pp. iv+531. (Para, Brazil.)

Index of Spectra. Appendix W. By Dr. W. M. Watts. (London: Wesley and Son; Manchester: A. Heywood and Son.)

Summary Report of the Geological Survey. Department of Mines. For the Calendar Year 1912. Pp. 544. (Ottawa.) 20 cents.

Proceedings of the South London Entomological and Natural History Society, 1913–14. Pp. xvii+158+plates. (London.) 4s.

Engineering Geology. By Prof. H. Ries and Prof. T. L. Watson. Pp. xxvi+672. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17s. net.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, and Graphite. By C. M. Johnson. Second edition. Pp. xi+437. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

Geological Map of the Caucasus. With Explanatory Notes. By Dr. F. Oswald. (London: Dulau and Co.) 15s. net.

Marine Biological Association of the West of Scotland. Annual Report, 1913. Pp. 125. (Glasgow.)

Nature and Development of Plants. By Prof. C. C. Curtis. Third edition. Pp. vii+506. (New York: H. Holt and Co.) 2.50 dollars.

Introductory Geology: a Text-Book for Colleges. By T. C. Chamberlin and R. D. Salisbury. Pp. xi+708. (New York: H. Holt and Co.) 2 dollars.

Die Raumorientierung der Ameisen und das Orientierungsproblem im Allgemeinen. By Dr. R. Brun. Pp. viii+234. (Jena: G. Fischer.) 6 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 44. Band iii. Erste Hälfte. Pp. 1761–1922. (Jena: G. Fischer.) 5 marks.

U.S. Department of Agriculture. Weather Bureau. Report of the Chief of the Weather Bureau, 1912–13. Pp. 252. (Washington: Government Printing Office.)

Union of South Africa. Mines Department. Geological Survey. The Geology of the Pilandsberg and the Surrounding Country. An Explanation of Sheet 12. With Sheet 12. By Dr. W. A. Humphrey. The Geology of the Haenertsburg Goldfields and Surrounding Country. An Explanation of Sheet 13. With Sheet 13. By A. L. Hall. (Pretoria: Government Printing Office.) 2s. 6d. net.

Bibliotheca Geographica. Jahresbibliographie der geographischen Literatur. Band xviii. Jahrgang 1909 und 1910. Pp. xvii+483. (Berlin: W. H. Kuhl.)

Wild Life. Vol. iv. No. 3. July. (Kingsway: Wild Life Publishing Co.) 2s. 6d. net.

Elektrische Spektralanalyse chemischen Atome. By Dr. J. Stark. Pp. viii+138. (Leipzig: S. Hirzel.) 5 marks.

Monistische Bausteine. Edited by W. Breitenbach. Zweites Heft. Pp. viii+252. (Brackwede-i-W.: Dr. W. Breitenbach.) 3 marks.

Die Umwelt des Lebens eine Physikalisch-Chemische Untersuchung. By Prof. L. J. Henderson. Pp. xviii+170. (Weisbaden: J. F. Bergmann.) 5 marks.

Quarterly Journal of Experimental Physiology. Vol. viii. Nos. 2 and 3. Pp. 103–302. (London: C. Griffin and Co., Ltd.) 15s. net.

Mind. New series. No. 91. July. (London: Macmillan and Co., Ltd.) 4s.

Smithsonian Institution. United States National Museum. Contributions from the United States National Herbarium. Vol. xviii. Part I. Classification of the Genus Annona. By W. E. Safford. Pp. ix+68+plates. (Washington: Government Printing Office.)

Norwegian Self-Taught, with Phonetic Pronunciation. By C. A. Thimm. Pp. 128. (London: E. Marlborough and Co.) 2s.

Machine Construction and Drawing. By A. E. Ingham. Book ii. Pp. xii+180. (London: G. Routledge and Sons, Ltd.) 3s. net.

The Physical Society of London. Report on Radiation and the Quantum-Theory. By J. H. Jeans. Pp. iv+90. (London: The *Electrician* Publishing Co., Ltd.) 6s. net.

The Journal of Egyptian Archæology. Vol. i., part iii. July. Pp. 159–232. (London: Egypt Exploration Fund.) 6s. net.

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THURSDAY, JULY 23, 1913.

SOUTH AFRICAN DIAMONDS.

The Diamond Fields of Southern Africa. By Dr. P. A. Wagner. Pp. xxv+347+xxxvi plates. (Johannesburg: *The Transvaal Leader*; London: The Technical Book-Shop, 1914.) Price *27s. 6d.* net.

THIS book is a greatly enlarged edition, in English, of Dr. Wagner's "Die Diamantführenden Gesteine Sudafrikas," which was published five years ago. The author states in his preface his aim to be that the book should "contain all that is worth knowing" concerning the subject of which it treats. If he has not altogether realised his ambition—and it is only necessary to glance at the list of 255 titles of works in his bibliography to realise the impossibility of doing so in a book of fewer than 350 pages—we may admit that he has certainly produced a work containing all that it is most important for prospectors, diggers, mining engineers, and investors, to whom the work is specially addressed, to know. Geologists also will find in it a good *résumé* of the work done in connection with the rocks containing the diamonds.

The first 250 pages of the book are devoted to an account of the primary occurrences of the diamonds in South Africa. The gems were first discovered at the Cape in 1868, and in 1874 the late Prof. Maskelyne showed that the rock in which they occur is a "peridotite" containing olivine, enstatite, and other minerals, for which the late Prof. H. Carvill Lewis, in 1887, proposed the name of "kimberlite." Much interest was aroused in 1899 by the fact established by Prof. Bonney, from the study of specimens obtained by Sir William Crookes, that the diamonds actually exist embedded in masses of "eclogite," a rock made up of garnet and augite, minerals which are found in the kimberlite. Since that date much discussion has taken place as to whether these masses of eclogite (which have received the local name of "griquaite") are nodules derived from a pre-existing rock or have been formed, like many other inclusions in the kimberlite, by a segregative action. Dr. Wagner suggests that a combination of the two hypotheses is possible and will best explain all the facts.

In the second division of the book, sixty pages are devoted to an account of the detrital deposits containing diamonds, including both those due to fluviatile and those due to marine action. The latter, occurring in German South-West Africa, are of especial interest to geologists. At points extending along the coast for 270 miles, but nowhere more than twelve miles from the sea, diamonds have been found. The district is nearly rainless and of most inhospitable character, but in certain valleys and depressions masses of sand and gravel occur yielding the diamonds—those obtained from these sources during the year 1913 being of the value of nearly 3,000,000*l.* Among the geologists who have studied the district, there appears to be much difference of opinion as to whether the rocks that have yielded the diamonds are in the "hinterland" or are now buried beneath the sea. It is interesting to note that certain guano islands off the coast have yielded diamonds, but, up to the present, not in sufficient numbers to pay the cost of prospecting.

The third portion of the book, which deals with "Diamond Mining Companies," does not call for remark from us, but the whole work may be recommended as a trustworthy and up-to-date treatise on the subjects with which it deals.

THE POPULARISATION OF EUGENICS.

The Progress of Eugenics. By Dr. C. W. Saleeby. Pp. x+259. (London: Cassell and Co., Ltd., 1914.) Price 5*s.* net.

DR. SALEEBY divides eugenics into natural or primary and nurtural or secondary. Natural eugenics is further sub-divided into positive, negative, and preventive. Few eugenists would support him in classing as eugenics much that he includes under the heading "nurtural," yet they would agree with him in general as to the desirability of making as favourable as possible the external conditions which influence nurture before and after birth, and of making education a real preparation for all that is important in life, including parenthood.

Positive eugenics means "the encouragement of worthy parenthood," negative eugenics "the discouragement of unworthy parenthood," and preventive eugenics the combating of "racial poisons," venereal diseases, alcohol, and lead. In treating these subjects Dr. Saleeby says, "We must be scientific or we are lost," and it is certainly true that he would have succeeded better if he had himself maintained a more scientific attitude. He falls short of it in particular in that he appears to judge of the validity of scientific work by the conclusions it arrives at. When the conclusions seem to him desirable, the work is accepted readily and uncritically, as, for example, that of the American Eugenics Record Office on the inheritance of epilepsy and feeblemindedness; when the conclusions seem undesirable, the work receives a very different treatment. Nevertheless, there is much contained in the book that is sensible and is presented with considerable force and literary skill, and this circumstance makes its faults all the more regrettable. Besides that to which allusion has already been made there are two others, first the obtrusive egotism of the writer, and secondly his habit of misrepresenting people from whom he differs in opinion. To say that "for years the chief object of the biometrical laboratory at University College has seemed to be, and now clearly is, to prove the inheritance of this or that human character is 'not Mendelian'" is little short of libellous. Nor is it just to assert "Newton was a weakly baby, prematurely born, and would promptly have been condemned as not worth keeping had the statistical school been in power in his day."

Finally we should like to know what eugenists maintain that "a high birth-rate and a high infant mortality rate are to be commended because of their 'selection value,'" or that "slums are defensible on the ground that in the course of time there is bred in them a slum race which withstands and even thrives in such conditions."

A PRINCETON COLLOQUIUM ON MATHEMATICS.

The Princeton Colloquium: Lectures on Mathematics, delivered September 15 *to* 17, 1909, *before Members of the American Mathematical Society in connection with the Summer Meeting held at Princeton University, Princeton, N.J.* By G. A. Bliss and E. Kasner. Pp. iii + ii + 107 + ii + 117. (New York: American Mathematical Society, 1913.)

THE first of the courses contained in this volume deals mainly with the theory of a set of implicit functions y_i, defined by a set of equations, $f_i=0$ $(i=1, 2, \ldots n)$, each involving the implicit functions and also the independent variables, $x_1, x_2, \ldots x_m$. In its general character the treatment is similar to that invented by Cauchy; but it is noticeable how the analysis has been simplified, and the results generalised, by improvements made quite recently. In particular, attention may be directed to the elementary character of the proof (by MacMillan) of what Prof. Bliss calls the preparation theorem of Weierstrass (p. 50): other illustrations might be given of a similar kind.

In carrying out the methods and ideas of Weierstrass, the principal result is that we obtain expansions for the y_i valid "in the neighbourhood of a point (a, b)." Prof. Bliss himself points out that one main object of his course is to deduce from the initial solution (a, b) something more than solutions of which we can merely say that they are valid very close to (a, b). By means of what he calls "a sheet of points" he is able to deduce from any initial solution (at an ordinary point) a sheet of solutions which only fail at "exceptional points," so we have something more or less analogous to Weierstrass's "analytical continuation" of a branch of a curve.

There are various interesting paragraphs on transformations from one plane region to another; a partial discussion of the singularities of the y_i, and a final lecture on existence-theorems connected with a set of differential equations.

Prof. Kasner's course on dynamics presents many features of novelty and interest. Broadly speaking, it is a quasi-geometrical study of trajectories with the aid of analytical (mainly contact) transformations. Many of the results obtained are of a remarkably elegant character: for instance, in the constrained motion of a particle on a surface under the action of positional forces, we have the theorem that the ∞^1 trajectories starting from a given lineal element have osculating spheres, at the common point, the centres of which lie on a conic in the plane normal to the element. A problem of more interest to physicists is this: given a system of curves in space, to find the condition that they may be trajectories, and to deduce the field of force from the set of curves when the proper condition is satisfied. This problem is fully discussed in chap. i., and the conditions for a conservative field are put into a remarkable geometric form.

We have also a section on least action, one on the space-time transformation used by Lorentz in the relativity theory, and various special illustrations of the general results.

Both these courses are so advanced that it is not easy to do them justice in a review: but from what has been said some idea may be gained of their general scope. Lectures of this kind are very valuable because they focus, so to speak, various lines of research upon a limited subject, and give an account of the really important results obtained.

G. B. M.

NATIONAL MUSEUMS AND SYSTEMATIC BIOLOGY.

(1) *Manual of the New Zealand Mollusca.* With an Atlas of Quarto Plates. By H. Suter. Pp. xxiii + 1120. (Wellington, N.Z.; J. Mackay, 1913.)

(2) *Catalogue of the Ungulate Mammals in the British Museum (Natural History).* Vol. ii., Artiodactyla, Family Bovidæ, Subfamilies Bubalinæ to Reduncinæ (Hartebeests, Gnus, Duikers, Dik-Diks, Klipspringers, Reedbucks, Waterbucks, etc.). By R. Lydekker, assisted by G. Blaine. Pp. xvi + 295. (London: British

Museum (Natural History); Longmans, Green and Co., 1914.) Price 7*s.* 6*d.*

(3) *A Revision of the Ichneumonidae based on the Collection in the British Museum (Natural History).* Part iii. Tribes Pimplides and Bassides. By C. Morley. Pp. xi + 148. (London: British Museum (Natural History); Longmans, Green and Co., 1914.) Price 5*s.* 6*d.*

(4) *British Museum (Natural History). A Monograph of the Genus Sabicea.* By H. F. Wernham. Pp. v + 82 + xii plates. (London: British Museum (Natural History); Longmans, Green and Co., 1914.) Price 6*s.*

(5) *Echinoderma of the Indian Museum.* Part viii., Echinoidea (1) "An Account of the Echinoidea." By Prof. R. Koehler. Pp. 258 + xx plates. (Calcutta: Indian Museum, 1914.) Price 20 rupees.

THE publication of these volumes justifies, we think, the view held by a large number of biologists, that one of the most important functions of a national museum is to act as a centre of research in systematic biology. These institutions alone possess collections sufficiently adequate in number of specimens and wide enough in scope for the successful accomplishment of such work, and besides collecting and storing such collections, it is clearly their duty to have them studied and classified.

Mr. Morley's work is a particularly forcible example of the importance of systematic biology, and of the responsibilities which rest on the nation of having such work done and published. At a time when the study of economic entomology is so much to the fore, and when it is more than ever established that the one successful method of controlling insect pests is by means of their natural parasites, a revision of the most important group of parasitic insects is doubly needed, for it is imperative that parasites should be correctly identified before remedial measures, based on their use as controlling agents, are introduced. We are glad to note that our National Museum is alive to its duties in this connection.

(1) We congratulate the New Zealand Government on its enterprise in publishing Mr. Suter's manual, and the author on the successful accomplishment of an enormous task. The extensive additions to our knowledge of the molluscan fauna of New Zealand during the last thirty years had rendered a re-issue of Hutton's manual of 1880 imperative. The latter work enumerated 447 valid species, whereas the present volume deals with 1079 species, besides 108 subspecies and varieties. Mr. Suter brings our knowledge of the mollusca of New Zealand right up to date, and by giving useful keys to the genera and species renders his work invaluable to students and specialists alike. His manual, moreover, possesses one advantage over Hutton's in that it is accompanied by a volume of plates. Mr. Suter does not, we think, correctly interpret the rules of priority in zoological nomenclature. The fact that a specific name is unaccompanied by a figure is not, in our opinion, sufficient excuse for the rejection of that name, provided the description is sufficiently clear for identification purposes. Otherwise Mr. Suter's work contains few serious errors or misprints, more especially as he had no opportunity of revising the later proof sheets. The name of the genus to which our common periwinkle belongs is, however, surely misspelt. The use of ten different qualities of paper in the production of this volume may have been unavoidable, but it does not enhance the appearance of the book.

(2) In this volume dealing with certain subfamilies of African antelopes, Mr. Lydekker continues his valuable catalogue of the Ungulata in the British Museum collections. The work is provided liberally with useful keys for the identification of families, genera, species and subspecies, and is accompanied by a number of useful photographs of heads and horns. We are very glad to notice that Mr. Lydekker has given special prominence to external characters, more particularly to the horns, for, besides rendering the work more readily acceptable to sportsmen, it is made of greater service to the museum curator who, more often than not, has only heads and horns at his disposal.

(3) We congratulate Mr. Morley on the rapid progress he is making with his important and much-needed revision of the Ichneumonidæ. This part follows the same general lines as the two preceding, and introduces nearly fifty species as new to science. Valuable as Mr. Morley's work is, it is as yet merely a collection of critical notes on species which the author has had the opportunity of examining. We think that such work would be more fittingly published in the Transactions of some learned society, or in some other serial publication, and this leads us to suggest that the British Museum authorities should consider the advisability of issuing a serial journal of their own for the publication of research such as Mr. Morley's, reserving their book publications for complete monographs, of the nature of those which are usually associated with their name. There is an abundance of work done under the auspices of the British Museum to justify such a periodical, and to keep it going. We hope that Mr. Morley's revision is but the necessary prelude to a fuller monograph.

(4) This monograph is based on a close examination of all the material of the genus contained in the principal European Herbaria, and the exhaustive nature of Mr. Wernham's work may be judged from the fact that he adds no fewer than sixty-two new species to the forty-four already known. All the species are briefly but concisely described, and there is an extremely useful key for their ready determination. The monograph, which is illustrated by twelve carefully lithographed plates, will be indispensable to all students of the Rubiaceæ and to curators of Herbaria who desire to have their material correctly labelled.

(5) In this memoir Prof. Koehler continues his valuable studies on the Echinodermata in the collections of the Indian Museum, and publishes the results of his examination of the Irregular Echinoids of the Spatangus group. Two genera and seventeen species are described as new to science. Several of the species had been given provisional new names by Anderson, and though they were unaccompanied by any kind of description, Prof. Koehler has, with characteristic courtesy, retained Anderson's names in all cases. The descriptions appear very clear and detailed, and are throughout accompanied by a wealth of illustrations. The work maintains the high standard set by Prof. Koehler in the six earlier memoirs in this series, of which he is the sole or part author.

W. M. T.

OUR BOOKSHELF.

A Manual for Masons, Bricklayers, Concrete Workers and Plasterers. By Prof. J. A. van der Kloes. Revised and adapted to the requirements of British and American readers by Alfred B. Searle. Pp. xii + 235. (London: J. and A. Churchill, 1914.) Price 8*s.* 6*d.* net.

IN this book will be found much useful information regarding the composition of various kinds of mortar, together with the effects of mortar of unsuitable composition. These subjects occupy practically the whole volume. The book opens with some physical and chemical principles, among which we note that the scaling of stone, brick and concrete structures is ascribed to osmotic pressure caused by the expansion of material in the pores. A valuable feature of the book is the number of photographs included showing defects in existing continental structures—similar defects may be found in many British buildings.

In the section dealing with dams it is pointed out that engineers generally have confined themselves to the results of tensile and crushing tests of the mortar employed, notwithstanding the fact that a mortar strong under test may become the cause of disintegration of the structure in consequence of its bad composition. Many of the dams built in the last half-century will be found to be leaking if they are examined carefully. The author gives photographs showing the defects in the Gileppe dam, near Verviers, in Belgium, and quotes it as the worst example known to him. This dam was built in 1870–75 and has a height of 157 ft.; the thickness at the base is about 220 ft. and the breadth at the top is 50 ft. Sandstone and limestone from neighbouring quarries were used and the mortar was composed of five measures of hydraulic lime from Tournai, one measure of trass and four measures of sand, so that four to five times too much lime was used. The leakage at first amounted to 5570 gallons a day, and after four years the outside of the dam remained permanently wet. In May, 1911, the upper part of the dam showed dry incrustations, lower down the masonry was wet under the incrustations, and at the lowest part of the steps the dripping water was like a small waterfall.

We have probably quoted enough from the book to indicate the value of its contents to the engineer, architect, builder, and student; it is, however, a matter of regret from the student's point of view that the price of this useful volume has been fixed rather high.

The History and Economics of Indian Famines. By A. Loveday. Pp. x + 163. (London: G. Bell and Sons, Ltd, 1914.) Price 2*s.* 6*d.* net.

THE literature of Indian famines is so extensive that Mr. Loveday has had no light task in compiling the main historical facts and formulating the conclusions contained in this enlarged prize essay. Famines are rightly regarded as natural calamities, caused by failures or irregularities of the monsoons. Indian historians record their occurrence under native rule. The policy of the native rulers was rather prevention (by wrong methods) than cure: the mortality was fearful. Under the East India Company the famine policy was uncertain and unsuccessful, the systems of famine-relief were inadequate, the economic conditions different from the present. After 1858 the Government adopted, in the great famine of 1860 in Upper India, a famine relief organisation which has been greatly developed but never abandoned. The Orissa failure, 1866–7; the excessive expenditure accompanying the success in Bengal, 1874; the great mortality in Madras, 1877, led to the Famine Commission of 1878–80. Since then Famine Codes have been framed for famine-relief administration. With subsequent experience, mistakes have been corrected and the Codes perfected, so that now famines—of work rather than of food—are managed effectively. Mr. Loveday describes briefly the various stages of policy, *e.g.* importation, emigration, poor houses, etc., etc.; the later tendency has been to greater generosity and decentralisation. Irrigation works (when possible) to grow food are being extended; and railways to transport it to distressed tracts. Meanwhile the economic condition of India is varying, changes must be recognised, protective measures and the wider economic problems—indebtedness, agriculture, cooperative societies, etc., etc. —must be considered together.

B.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1914. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Fifty-first annual publication. Revised after Official Returns. Pp. lxxix + 1500. (London: Macmillan and Co., 1914.) Price 10*s*. 6*d*. net.

As the years go by, the growth in size and usefulness of this welcome summary of the world are signs not only of the value of the contents, but of the carefulness which marks its compilation. Much wants more, and many readers would, no doubt, appreciate the extension of the introductory tables to include world surveys of other commodities than coal, gold, etc. The maps this year deal with new political boundaries in Balkania and Mongolia, the extension of railway communications in America, and the position and number of the wireless stations of the world. Many portions of the main text have been subjected to a thorough revision by competent authorities, and no effort seems to have been spared to bring the fifty-first issue thoroughly up-to-date. The complete bibliographies add specially to the usefulness of this indispensable year-book.

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.*]

Man's Chin: a Dynamical Basis for Physical and Psycho-physiological Utilities.

To account for the presence of man's chin at least three different explanations have been brought forward and discussed:—(1) That the chin has been evolved by sex selection for its æsthetic value; (2) that it was needful for the development of the genio-glossal muscle and speech; (3) that with man's erect posture the chin has been chiefly useful in affording room for important structures in the throat, and in protecting them during combat, etc. These explanations have so far met with very little acceptance.

A conception of the chin as a *dynamical* factor in both mastication and speech does not appear to have received attention. An engineer examining the dental mechanism as a type of machine new to him would, on finding there was a considerable bulk of constructional material projecting from the chief moving member, be nearly certain to ask—What does this do? The chin mass is situated at the outer end of the jaw lever, where its momentum is greatest. It is built up in the heavier material used in the general construction. There is another point, too, that one should not too readily dismiss as a mere coincidence. Every rotation movement of the mandible during its elevation or shutting has combined with it a movement—obliquely upward and backward—of translation. The combined movements are so directed that at some parts of the jaw the resultant velocity is less than would exist if either component were to act alone; and at about a point situated between the jaw angle and the condyle, the resultant velocity is so small that some observers mistakenly believed it to be nil. At the chin, on the other hand, the directions of the component movements are such that the resultant velocity reaches nearly its maximum acceleration.

My suggestion is not quite that the chin is simply man's masticating hammer; something rather less crude than a purely percussive function is conditioned by the momentum of the chin. No doubt the momentum of the chin may appear to be a very small contribution to the considerable muscular force often used in chewing. Yet on the teeth themselves many morphological details that have been preserved as distinct specific features are so small that we do not yet know what the particular utilities are that determined their shape and survival. Further, there is another peculiarity in the mandible movement that may have some significance in this connection. During a (supposable) uniform movement of rotation about the condyle as horizontal axis, the accompanying translation movement is not uniform, but relatively varied—slow or small in the beginning, quicker in the middle, and slower again towards the end of the condyle path. This is favourable to the normal *rhythmical* movement of the jaw by giving in some degree a pendulum-like character to its swing. And it so happens that the position of maximum velocity (and momentum) coincides with the position of greatest resistance and food-strain in chewing—that is, when the cutting-edges of the external blades of the lower cheek teeth are just about to pass their upper opponents in the inward-and-upward shearing thrust. The chin momentum operates most strongly just about the point where it is most useful in preserving the rhythmical movement of mastication, so as to render less necessary any *consciously*-directed variation in the muscular effort put forth in any single chewing stroke.

Then, in the numerous smaller chewing movements for the finer reduction of food morsels, the chin mass (by both inertia and momentum) has at least some value as a "balance," controlling and guiding the niceties of direction in the thrust. The utility of balance influences the construction of many man-made implements (pen- or brush-holder, razor handle, spear, etc.) in the use of which some precision is required; this feature in construction has usually been adapted and has survived quite independently of any conscious or theoretical estimation of its special function. The obvious objection that animals manage the "niceties" of mastication without a chin could be met only by going more fully into the dynamics of the subject. This much at least can be stated here as being susceptible of proof—that as compared with the prognathous savage or the ape, the dental apparatus of modern civilised man is the "finer" machine, in so far as it is the better adapted for those shearing stresses by which tough foodstuffs are comminuted with economy of effort.

The above suggestion of "balancing" and "steadying" utilities can also be applied to the rapid and yet delicately controlled movements of the mandible in speech. The man who wrote a book on "The Speech of Monkeys" might possibly have had hope of more success in interpretating the "language" of these animals if only he could have subdued and steadied their jibberings and chatterings by providing them with good weighty chins. D. M. SHAW.

Eltham, S.E.

Meteoric Streaks and Trains.

PROF. C. C. TROWBRIDGE, of New York, has been conducting an interesting investigation, during recent years, into the heights and velocities of the streaks and trains of meteors. He has been collecting old records of these phenomena, and will be glad to receive any new materials which may be gathered during this year's Perseid shower. Every year brings us some brilliant Perseids leaving durable streaks, and it is important that when these appear the drift amongst the stars should be noted at short intervals. In the case of a streak enduring ten minutes, a series of diagrams showing the positions of the streak and neighbouring stars every two minutes would be valuable.

There is a large amount of data available from past observations, but it is for the most part of very rough imperfect character, and we require more exact and complete records before we can determine the exact heights of the streaks and the motions of the outer atmosphere. However, the discussion so far as it has gone proves that the streaks are usually from fifty to sixty miles high, and that their motion is often more than one hundred miles an hour. A very destructive hurricane on the earth's surface would about equal this, so that it is certain that the upper tenuous air is influenced by currents of far swifter character than the atmosphere immediately overlying the earth.

If observers of meteors will only carefully record meteoric streaks and trains whenever they are seen we shall soon be in a position to ascertain more trustworthily and definitely the behaviour of these curious afterglows. From balloon ascents it has been concluded that the general drift of the air in the region of ten or fifteen miles altitude is to E. and S.E., and this precisely accords with the direction of the majority of meteoric trains between about fifty and sixty miles high.

W. F. DENNING.

Bristol, July 13.

Climatic Change.

I HAVE just seen the translation of Prof. Albrecht Penck's lecture on "The Shifting of the Climatic Belts," printed in the *Scottish Geographical Magazine* for June, 1914. The main line of the author's argument is that certain lakes—*e.g.* Lake Chad in the Sahara, the lakes of Mexico City, and of the Titicaca basin, being very slightly salt, indicate an *increasing* precipitation, and during the so-called "pluvial period" were drier than at present, owing to a shifting of the arid belt equatorwards.

Surely it is more reasonable to attribute the comparatively slight salt content to the fact that the basins have only recently ceased to have an outlet, owing to a *decrease* in the precipitation. A slow fluctuating decrease in the rainfall of Mexico has been practically proved by Prof. Ellsworth Huntington (*e.g.* "The shifting of climatic zones as illustrated in Mexico," Bull. Amer. Geogr. Soc., vol. xlv., 1913, Jan.–Feb., and also his recent memoir on the "Climatic Factor"). In the case of Lake Chad, K. v. Zittel, an accomplished observer, describes evidence of a former greater extent (*Palaeontographica*, vol. xxx., 1883, p. 39). Information as to whether the lake has an old outflow channel would be valuable.

So long ago as 1876 A. Agassiz, in his "Hydrographic Sketch of Lake Titicaca" (Proc. Am. Acad., vol. xi., 1876, p. 268), wrote: "The whole of this district is receiving a much smaller waterfall than in former times."

Prof. Penck is unfortunate in his examples; the weight of evidence against him, pointing to a former moister period on the equator side of the arid belts, is too great to be ignored. And as he admits desiccation on the poleward sides of these belts, the facts suggest that the dry area may vary in breadth as well as in position, and that the "pluvial period" had a real existence—*outside the glaciated regions.*

CHAS. E. P. BROOKS.

"Homeleigh," 3 Roseleigh Avenue, Highbury, N.
July 17.

THE PLUMAGE PROHIBITION BILL.

BEFORE these lines are published the fate of the Plumage Prohibition Bill may have been decided. It seems little to our credit that London should be the chief market for the nefarious traffic which this Bill was framed to abolish; and this view was surely endorsed by the House when, on the second reading, the Bill was passed by a majority of nearly three hundred. Nevertheless, during the committee stage the Bill was virulently opposed by a small, well-organised minority, including some actually engaged in the sale of plumage for millinery purposes.

Unfortunately, the hands of the opposition have been strengthened by the action of "The Committee for the Economic Preservation of Birds"—a committee which, strangely enough, does not contain the name of a single ornithologist of repute. So completely have these opposing forces contrived to play into one another's hands that it is probable that, to save the Bill, it will have to be modified. For total prohibition a schedule will have to be substituted, which must be so framed as to secure the safety of such species as are at present in actual danger of extermination.

It would be useless to urge the need of preserving these threatened species because of their immense value as living witnesses of the evolution theory; for science, and scientific problems, have little weight in this country. But, if for no other reason than that of its inhumanity, this ghastly traffic should be ended.

The contention that if this Bill passes a large number of workpeople will be thrown out of employment has been shown, on figures furnished by the trade itself, to be without justification. Equally groundless is the assertion that the placing of the Bill on the Statute Book will simply divert the trade to Paris without saving the life of a single bird. If there were any sort of foundation for this, the French Chamber of Commerce would not have implored the British Government to throw out this Bill. Furthermore, we are assured that if this Bill passes, Germany will follow our lead. This done, the plume-trade in Europe is dead.

If only an emasculated Bill succeeds in running the gauntlet of trade interests a step in the right direction will have been achieved. If, on the other hand, the present Bill is defeated, then it is fervently to be hoped that a new Bill will be introduced at the earliest possible moment; and having regard to the voting on the second reading of the present Bill, there is every reason to regard its success as assured.

SPACE AND TIME.[1]

"FROM this time forth space and time apart from each other are become mere shadows, and only a kind of compound of the two can have any reality." So spoke Herrmann Minkowski in 1908. But his statement has not yet been realised.

[1] H. A. Lorentz, A. Einstein, H. Minkowski: Das Relativitätsprinzip. A Collection of the Classical Papers in the Development of the Theory of Relativity, from 1895 to 1910. Pp. 89, with portrait of Minkowski. (Leipzig: B. G. Teubner, 1913.) Price 3 marks.

It is still the elect to whom it is given to escape from the bondage of their own consciousness so completely that they can think of time as nothing more than the most convenient means of ordering events. Sir Oliver Lodge was voicing the feeling of the man in the street when, at Birmingham, he said: "Surely, we must admit that space and time are unchangeable: they are not at the disposal even of mathematicians."

It is not so long since a similar divergence of view existed in respect of the other fundamental dynamical magnitude *mass*. But here the controversy has subsided; the mass of a body is still something more than a shadow, though no teacher of dynamics would to-day think of defining it as "the quantity of matter" in it. Rather the conception has gained in concreteness through its separation from the crude intuitive notion of heaviness, through the realisation that no precise definition is possible apart from the uniformity which is expressed in the laws of motion.

A reader of "The Grammar of Science" might well have exclaimed: "From this day forth mass is a mere shadow." But no one now would assert that mass as a measurable quantity is an *a priori* and obvious concept, independent of the phenomena of motion.

Now, apart altogether from the particular assumption of the principle of relativity that electrical phenomena cannot reveal an absolute motion, it was implied by its founder that as measurable quantities space and time are on exactly the same footing as mass, in that they are inseparable from the uniformities which they are used to describe. They are no more at the disposal of the metaphysician than of the mathematician. The psychologist is within his province in endeavouring to elucidate the nature of the consciousness of duration, but in the region of exact physical measurement this aspect of time is eliminated, so that only experiment can say whether there is, for instance, a unique sense in which two events at different places are simultaneous. It is exactly this which experiment has failed to do. Whether it will ever do so cannot be foreseen; the principle of relativity seeks to examine some of the consequences of assuming that it will not. But it is for the present generation to decide whether it is a sound scientific principle that time, like other physical concepts, is dependent for its significance on the observation of uniformity in physical processes, and that the reality of it to our minds is only due to the unbroken regularity of these processes. In this sense we may surely say with Sir Oliver Lodge that space and time are unchangeable, but at the same time we must leave it to nature to tell us what they are, and not foist upon the measures of them a metaphysical significance borrowed from a conceptual scheme which has been outgrown by experiment as the dynamical universe conceived by Laplace has been. The small volume before us embodies the classical papers, in which the gradual transition from the Newtonian thought about space and time to this point of view is developed.

THE HAVRE MEETING OF THE FRENCH ASSOCIATION.

THE arrangements are now complete for the visit of members of the British Association who have been unable to take part in the meeting in Australia, to the congress of L'Association Française pour l'Avancement des Sciences at Havre, beginning on Monday, July 27, and ending Sunday, August 2. Nearly one hundred members have intimated their intention of availing themselves of the courteous and kindly invitation with which they have been honoured by the French society. Among them are about fifty delegates of the associated and affiliated societies which are in correspondence with the British Association. The council of that association has approved of the holding of a meeting of the conference of delegates at Havre during the present year, to be followed later on, if necessary, by a meeting in London for any formal business that may still require to be done.

The session of the conference of delegates will be held at Havre on Tuesday, July 28, at 2.45 p.m., and as it forms part of the accepted programme of the French Association, it is hoped that it may be attended by many members of that association. It will be presided over by Sir George Fordham, who will deliver an address, in which he will direct attention to the work of the conference, since its establishment in 1885, and that will be followed by a discussion, in which the functions of local societies will, it is hoped, be considered from an eminently practical point of view. There is, it is understood, a strong feeling among scientific men in France in favour of the organisation of local societies in that country upon similar principles, and it would be very satisfactory if one result of this joint meeting should be to facilitate the movement in that direction.

At the opening meeting of the congress, to be held in the Grand Theatre, Place Gambetta, on Monday, July 27, at 2.30, Sir William Ramsay will speak as the principal representative of the British Association. In the sectional meetings on the four following days, several papers will be contributed by the English visitors. On Friday, July 31, at 2.30, a general Anglo-French meeting will be held, at which it is proposed that the subject of the Channel Tunnel should be discussed, and on the evening of the same day a discourse will be delivered by a member of the British Association in the Grand Theatre. Thursday, July 30, will be devoted to an excursion to Rouen, and the congress will conclude with a cruise and visit to Cherbourg on the Transatlantic steamer *La Touraine*.

The committee to which the council of the British Association has entrusted the making of these arrangements owes much gratitude to Dr. A. Loir, who two years ago conveyed the invitation of the French Association to the meeting at Dundee, and has been most assiduous in his care for the comfort of the English visitors. The invitation is felt to be a very graceful act on the part of the French Association.

OSCILLATIONS OF FRENCH GLACIERS.[1]

THIS part of the valuable publication issued by the French Government, is chiefly devoted to the glaciers of Savoy, because, though those of the Pyrenees have been studied with the same thoroughness, they have not attracted so much notice in the past, and thus less information was obtainable. In Savoy also the history of the glaciers of the Mont Blanc range is far more complete than in the Maurienne, because, fewer than seventy years ago, these districts were but rarely visited by travellers. Careful search in the archives and libraries of Annecy, Geneva, and Chamonix has discovered more than could have been anticipated about the history of the Mont Blanc glaciers, and that of the Glacier du Bois has been traced back with fair completeness for more than three centuries.

The earliest maps, restricted to northern Savoy, are dated 1555 and 1562, but these are practically worthless, and the first on which the glaciers are indicated is as late as 1742. They are, however, mentioned in some detail in documents written in 1580 and 1605, during which time a notable advance of the ice evidently did serious damage to property in the valley of Chamonix. After this the information is for a time less complete, but it rapidly improves with the coming of travellers, and from about 1780 illustrations provide another source. Several of them are reproduced in this publication, and though often rude, they form valuable records of the extent of the ice at particular dates. The glaciers of which information has been obtained—not in all cases equally complete—are six in number, and their oscillations show a general, though not an exact correspondence. Including the glaciers of the Maurienne, their advances and retreats indicate a certain periodicity. From 1605 to 1894 (inclusive) there have been seven of the former, the longest interval being forty-four years and the shortest thirty-one years, giving an average of forty years in 284 years; of these, the advances about 1610, 1716, and 1822 were exceptionally great, and these maxima are 106 years apart. Numerical correspondences are also noted between two other groups of oscillations, with the result that the figures suggest general periodicities of about thirty-six years, and special of three times that amount.

The mean temperature and rainfall, of which records are given, must produce effects on these movements, and it is remarkable that the former, between 1773 and 1860, rose steadily by 0·871° C. and has since then declined by 0·698° C. The remainder of the volume is devoted to glaciers in the Pyrenees, but we must be content to mention these, as the information is more imperfect, and only to direct attention to another part (Annexe du Tome v.) of the same publication, which contains a valuable series of maps of the hydrography of the river-basins of the Bréda, the Arc, and the Durance. T. G. B.

[1] Ministère de l'Agriculture: Direction Générale des Eaux et Forêts. 2e Partie, Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques (Régions des Alpes et du Sud-ouest). Études Glaciologiques Savoie-Pyrénées. Tome iii., 1-12.

A NATURE-RESERVE IN SPITSBERGEN.

THE question of the government of the Arctic isles of Spitsbergen is occupying an international commission, and meanwhile Prof. H. Conwentz opportunely directs attention to the need for the demarcation of a Polar natural history reserve. In the second part of vol. iv. of his *Beiträge zur Naturdenkmalpflege,* he brings together the views of a number of scientific men who have visited Spitsbergen, and points out the wanton destruction of reindeer, polar bears, and other animals, that is encouraged by many of the pleasure-expeditions to the north. The establishment of a recognised government would enable such "sport" to be rigorously held in check. As Prof. Penck reminds us in his contribution, a traveller may land in summer on Spitsbergen, may see the antlers of reindeer and their tracks in the soil, and yet may never come across a single individual. The accessibility of Spitsbergen makes it especially attractive to the geologist and the naturalist, and the scale of its scenery provides an admirable illustration of our own islands during the waning of the Quaternary ice-age.

A complete nature-reserve is now proposed for the region north-west of the Ice-fjord, leaving the coal-mining area of Advent Bay and the whale-fisheries of Green Harbour in a larger area over which partial control may be effected. Anyone who has seen the fog roll like a curtain from the ice-flecked water, and the great panorama of peaks and glaciers appear as a first vision of the Arctic world, will assuredly give sincere support to those who would limit the private exploitation of Spitsbergen. Prof. Sapper has the foresight to propose the prohibition of hotels in proximity to glaciers of special beauty. He directs attention to such geographical features as the polygonal soils and the hillsides grooved by arid erosion, and to the marring effect that factories might have upon landscapes of such exceptional interest. We may add that the driving of a road across the boulder-clay of the von Post Glacier would deprive geologists of one of the most valuable "modern instances." The conditions along the vales from which the ice has shrunk away are those amid which our palæolithic ancestors founded man's dominion in European lands. If scientific workers seek to preserve Spitsbergen from the fate that has overtaken Switzerland, it is in no selfish spirit but in the desire to retain for all an intellectual heritage. GRENVILLE A. J. COLE.

DR. ADOLF LIEBEN.

DR. LIEBEN, whose death occurred on June 6 at the age of seventy-eight, was born on December 3, 1836, at Vienna, and was the son of a merchant in that city. Until the age of twelve his education was entrusted to the care of Moritz Hartmann, who was later to make a name as a poet. Later young Lieben began to interest himself in chemistry, and attended lectures at the university under Redtenbacher and Schrötter. In 1855 he entered the University of Heidelberg, and worked in Bunsen's laboratory, where he met many students—Beilstein, Baeyer, Landolt, L. Meyer, and Roscoe—who were destined later to become distinguished in the science of chemistry.

After taking his doctorate in 1856, he left Heidelberg, and studied for a time in Paris. On the recommendation of Dumas he entered the alkali works of Kuhlmann in Lille; but industrial chemistry had no attractions for him, and in 1859 he was back again in Vienna in Schrötter's laboratory, where he remained until 1861. In 1862 he made a second visit to Paris, where he met Cannizzaro, who offered him a post in the laboratory at Palermo, where he ultimately became professor. In 1867 he was elected to the chair of chemistry at Turin, and remained there until 1871, when he was appointed to a professorship at Prague. In 1875, on the death of Rochleder, he was called to fill one of the two recently created chairs at the new University Institute at Vienna, where he remained for thirty years, actively engaged in teaching and research, until his failing health obliged him to retire. He is described as a lucid lecturer and brilliant experimenter, and his lectures were largely attended by students, many of whom later became secondary-school teachers or obtained important positions in various chemical industries.

The esteem in which Lieben was held by them and by his colleagues is shown by the celebrations which attended his fiftieth jubilee and seventieth anniversary in 1906, and by the numerous honours and distinctions which were conferred upon him in his later years. His researches cover a wide field, and include important investigations in inorganic and physical chemistry; but his principal contributions lie in the domain of organic chemistry. He was among the earliest investigators to adopt Kekulé's new structural formulæ.

One of his first researches was carried out in Wurtz's laboratory in Paris (1856–1859) on the action of chlorine on acetaldehyde, alcohol, and ether, which led to the discovery of the chloroacetals and dichloro-ethers; but his most productive period was during the time he held the chairs at Turin and Vienna, where he became associated with Rossi and later with Zeisel and with Haitinger. In Turin he began his investigations on the synthesis of the alcohols by the method of Piria and Limpricht by heating the calcium salts of the fatty acids with calcium formate, and thus obtaining aldehydes which on reduction yielded the alcohols. In this way he prepared a series of alcohols from methyl alcohol to hexyl alcohol. This was followed by a study of the aldol and crotonic aldehyde condensation, which he applied to a variety of aldehydes, and obtained by reduction new glycols and alcohols. It was at this time that he discovered the iodoform reaction for ethyl alcohol which goes by his name. But one of his most interesting contributions which he carried out with Haitinger during 1883–85 is on the structure of chelidonic acid (a constituent of the yellow juice of the greater celandine), which was recognised as a pyrone derivative, and was converted into a hydroxypyridine carboxylic acid by the action of ammonia.

Lieben also interested himself in what is now termed biochemistry. By the aid of the iodoform reaction he was able to detect small quantities of alcohol in urine, and also gave some attention to the reduction products of carbon dioxide under the influence of light in an attempt to elucidate the process of plant assimilation. J. B. C.

THE REV. OSMOND FISHER.

FULL of years, but with interests unabated and working until within a few days of the end, the veteran geologist, Osmond Fisher, passed away on July 12, at the age of ninety-six.

He was born on November 17, 1817, at Osmington, in Dorset, of which place his father, the Rev. (afterwards the Ven.) John Fisher, was vicar. Educated at Eton under Dr. Keate and at King's College, London, he proceeded in 1836 to Jesus College, Cambridge, from which he graduated as eighteenth wrangler in 1841, the year in which Stokes was senior. He was ordained deacon in 1844, and priest the following year. After a short period of clerical work at Writhlington, near Radstock, and Dorchester, he returned to Cambridge in 1853 as tutor of Jesus College, but left after four years' work on his presentation to the college living of Elmstead, near Colchester. In this year, also, he married Maria Louisa, daughter of Mr. Hastings N. Middleton, of Ilsington House, near Dorchester. In 1867 he was presented to another college living, that of Harlton, near Cambridge, and here he resided until his retirement in 1906. The last eight years of his life were spent in the home of his eldest son, the rector of Graveley, near Huntingdon. He lies buried in the quiet Harlton churchyard, within sight of his forty years' home.

From his childhood, Mr. Fisher was a geologist. Fossils collected from the Coral Rag before he was fifteen are now in the Sedgwick Museum. His contributions to pure geology relate to beds of Cretaceous or more recent date. Among them may be mentioned his papers on the Bracklesham beds, the phosphatic deposits of the Cambridge Greensand, and the mammaliferous deposits of Barrington, as well as those on the "trail" and the denudations of Norfolk.

It is, however, as a physical geologist that Mr. Fisher is most widely known. His originality in this branch of geology is shown by the facts that in 1841 the contraction theory of mountain-formation occurred to him, and that in 1855 he attributed the Visp earthquake of that year to the growth of a fault. That he was by no means a slave to his own theories is equally manifest, for by 1873 he had abandoned the contraction theory, believing the cause invoked to be incapable of producing the known inequalities of the earth's surface. With the contraction theory went also his belief in the practical solidity of the earth's interior, and from this time dates his championship of the hypothesis of a liquid substratum between the solid crust and core of the earth, and of the well-known theory of mountain-building with which his name will always be connected. It is not too much to say that the leisure of his last forty years was spent in developing this theory, and in meeting, with unfailing courtesy, the objections which from time to time were urged against it. On the whole, his work failed to attract the attention and criticism of mathematicians in this country, but by geologists, both here and abroad, it has always been highly valued. The Geological Society, ever ready to welcome the aid of mathematicians, awarded him a grant from the Lyell fund in 1887, the Murchison medal in 1893, and the Wollaston medal in 1913.

Charles Davison.

NOTES.

At the thirty-third annual meeting of the Society of Chemical Industry held in Nottingham last week it was announced that the society's medal had been awarded to Sir Henry Roscoe, the first president, for his services to science, education, and the society. In his presidential address, which was read in his absence, Sir William Crookes said that the world is still greatly in need of able researchers, perhaps more so now than at any previous time in its history. Discoveries of vast importance are waiting their Newtons. But is not the attitude of the public towards investigators lacking in understanding and imagination, and do not the authorities treat scientific exploration in a niggardly spirit? Scientific research is being starved. The allotment of public moneys to the furtherance of scientific work, the tangible recognition of the services of scientific men, the provision of opportunities for all kinds of investigations of scientific problems without reference to their immediate commercial value—these are the benefits which should be looked for at the hands of the Government and of the nation. On the same day that Sir William Crookes's address was read, Mr. Cowan asked the Prime Minister in the House of Commons whether any existing fund is available out of which men of science may be compensated for losses incurred by them in doing unremunerative scientific work when such work has proved to be of advantage to his Majesty's Government and subjects; and whether, if no such fund is available, he would consider the advisability of providing funds for meeting such cases? In his reply, Mr. Asquith mentioned that nine civil list pensions were awarded for scientific services last year, and he said: "I am not satisfied that further provision is necessary." A list of these pensions was given in our issue of July 9 (p. 485), but we suggest that such grants, made partly on account of inadequate means of support, do not give a satisfactory answer to Mr. Cowan's question or provide the encouragement of research to which Sir William Crookes referred.

The death is announced, in his sixty-sixth year, of Sir Christopher Nixon, ex-president of the Royal College of Physicians of Ireland, and Vice-Chancellor of the National University of Ireland. He was the author of a number of books on medical subjects and also the first president of the Royal Veterinary College of Ireland.

The Royal Agricultural Society of England is offering a medal, together with life membership of the society, for a monograph or essay, which has not been previously published, giving evidence of original research in any agricultural subject or any of the cognate agricultural sciences applicable to British farming. Intending candidates should forward their essays to the secretary of the society at 16 Bedford Square, W.C., not later than July 25.

The American Museum of Natural History has received 1,000,000*l.* under the will of the late Mrs. Morris K. Jesup, who died on June 17. According to *Science*, Mrs. Jesup made other bequests to public institutions amounting to 690,000*l.*, including 60,000*l.* to Yale University. Mrs. Jesup's husband, who died in 1908, became president of the Museum of Natural History in 1882, and devoted a large part of his time and energy to its interests. In his lifetime Mr. Jesup gave more than 200,000*l.* to the museum, and under his will it inherited an additional 200,000*l.*

We understand that a National Council is about to be formed for the purpose of combating venereal disease. The preliminary arrangements are being made by Sir Thomas Barlow, president of the Royal College of Physicians, Sir Rickman Godlee, until recently president of the Royal College of Surgeons, Sir Francis Champneys, president of the Royal Society of Medicine, the Bishop of Southwark, and Major Leonard Darwin, president of the Eugenics Education Society. A meeting has been held at which, besides those mentioned above, those present included Sir Clifford Allbutt, Sir W. Osler, Sir A. Pearce Gould, Sir Henry Morris, Sir Wilmot Herringham, and Mr. Charters Symonds.

At the recent July meeting of the executive committee of the British Science Guild, Sir Norman Lockyer, K.C.B., F.R.S., in the chair, a special committee was appointed to inquire into and report upon the question of the provision, in this country, for veterinary research. A special committee, consisting of the president, the Right Hon. Sir William Mather, Sir Norman Lockyer (chairman), Lieut.-Colonel Sir Chas. Bedford, Hon. Sir John Cockburn, Prof. Meldola, Major O'Meara, Sir Boverton Redwood, Sir Ronald Ross, and Prof. Silvanus P. Thompson, was appointed to consider and report upon various matters arising in connection with science and the State and the encouragement of discovery referred to in the address delivered by Sir Ronald Ross at the annual meeting of the guild, at the Mansion House, on May 22. A report was received from the technical optics committee dealing with the inadequate provision for, and the unsatisfactory state of, technical training in optics in this country, and proposals for the establishment of a British Institute of Technical Optics were considered.

The following list of members of the Imperial Transantarctic Expedition has been officially announced:—*Weddell Sea Party*: Sir Ernest H. Shackleton, leader of the expedition; Mr. Frank Wild, second in command; Mr. G. Marston, Mr. T. Crean, Captain Orde Lees, Lieut. F. Dobbs, Lieut. Courtney Brocklehurst, Mr. J. Wordie, geologist; Mr. R. W. James, physicist and magnetician; Mr. L. H. Hussey, assistant magnetician and meteorologist; Mr. F. Hurley, photographer and kinematographer; Mr. V. Studd, geologist; Lieut. F. A. Worsley, in navigating command of the *Endurance* on the voyage from London to Buenos Aires and the Weddell Sea, and afterwards to take part in the surveying and exploring of the coast; Mr. Jeffreys, Mr. Hudson, and Mr. A. Cheetham. *Ross Sea Party*: Lieut. Aeneas Mackintosh, leader and meteorologist; Mr. E. Joyce, zoologist; Mr. H. Ninnis; Mr. H. Wild; and Dr. Macklin, surgeon. There only remain two vacancies, and these are to be filled by another doctor and a biologist. The arrangements for the Ross Sea ship *Aurora* are not yet quite complete, but the *Endurance*, with the Weddell Sea party, will sail in a few days.

ONE half of the present summer has gone, and the weather so far has been generally fine. The weekly weather reports issued by the Meteorological Office for the first six weeks of summer, ending July 11, show that the mean temperature for the period is in excess of the average over the whole of the United Kingdom, except in the north of Ireland, where it is normal. The greatest excess is 2° in the east and north-east of England. The rainfall differs very materially in the various districts. In the north-east of England the aggregate rainfall is 166 per cent. of the average, in the midland counties 144 per cent., in the south-west of England 138 per cent., in the Channel Islands 110 per cent., and in the north-west of England 103 per cent. of the average; in all other districts of the United Kingdom there is a deficiency. The least rainfall for the six weeks in any district is 2 in. in the west of Scotland, which is 49 per cent. of the average. In the north of Ireland the rainfall is 60 per cent. of the average, in the north of Scotland 62 per cent., in the south of Ireland 67 per cent., in the east of Scotland 82 per cent., in the south-east of England 84 per cent., and in the east of England 96 per cent. of the average. The duration of bright sunshine is in excess of the average over the eastern section of the kingdom, but it varies somewhat in the western section. At Greenwich there have already been twelve days since the commencement of June with a shade temperature of 80° or above, whilst the average for the three summer months in the last seventy years is only thirteen. The rainfall is decidedly deficient of the average, whilst the sunshine is largely in excess of the average.

THE University of Pennsylvania Anthropological Publications (vol. iii., No. 3) is devoted to an account of excavations at Urokastro, in eastern Crete, by Miss E. H. Hall. The importance of this investigation lies in the fact that while the work of Sir A. Evans and others has hitherto been mainly devoted to the culture of the Bronze age, little has been systematically done to work out the Iron-age culture. This raises important ethnological problems; and the writer ventures the theory that in the remains discovered it is possible to recognise, in order, three great invasions of Crete from the north: those of the Mycenæans, Achæans, and the Dorians.

IN the Perthshire Society of Natural Science Transactions, vol. v., the Rev. G. A. Frank Knight directs attention to a little-known series of ancient fortifications on the western side of Ben Scallaidh at a height of about 2000 ft. above the sea, and fully two-thirds of the way up the Kirkton Glen. He counted in all eight lines of fortifications which reveal enormous labour and no small skill in construction. In some respects they present features resembling the well-known prehistoric forts of Peeblesshire which have been described by Dr. D. Christison (Proc. Soc. Antiq. Scot., xxi., 1886–7, p. 13f.). The writer justly remarks that this remarkable series of ancient fortifications should be investigated by a skilled archæologist, who, preferably, is also a trained military strategist.

DR. J. E. POGUE, mineralogist in the U.S. National Museum of Washington, has been engaged in collecting material for a monograph on the turquoise, from the mineralogical, historical, and ethnological points of view. Mr. B. Lanfer, associate curator of Asiatic ethnology, was invited to cooperate in the work. As the publication of Dr. Pogue's monograph has been delayed, Mr. Lanfer has now published "Notes on Turquoise in the East," as Publication No. 169 of the Field Museum of Natural History. He discusses in detail all available information regarding the stone in India, Tibet, and China. He has collected much interesting information which he publishes, with full references, in this well-illustrated and scholarly monograph. The turquoise, from its power of repelling evil spirits, has always been valued in the East, and we have here a full account of the stone from the economical as well as the religious point of view.

BY the liberality of Mr. P. G. Gates the United States Museum was enabled in 1905 to resume the investigations conducted by Dr. J. W. Fewkes into the culture of the ancient Pueblos of the Upper Gila river region in New Mexico. Immense numbers of specimens, particularly of perishable objects found in caves, render it possible to throw much light on an archæological area hitherto not scientifically explored. A remarkable series of specimens illustrates the cult of fire, fire-sticks, invested with a sacred character, being apparently offered, when worn out, in shrines. Numerous ceremonial cigarettes, consisting of sections of arrow-reed, tightly filled with artemisia and other aromatic herbs, were found in the ceremonial caves, and in the inhabited houses a number of "cloud-blowers," stone tubes of various sizes, used for blowing clouds of incense smoke during the tribal rites. These people were ignorant of metal-working, in one case only a lump of raw copper, rubbed and smoothed like a stone, having been found. The results of his expedition are well described by Mr. Walter Hough, ethnological curator of the museum, in Bulletin 87 of the Smithsonian Institution.

"MAN and the Microbe" is the title of an article by Prof. Winslow in the *Popular Science Monthly* for July, in which he describes the various ways by which infective diseases are spread, and discusses some of the means of prevention. To show how much has been done in the last-named direction, he points out that in every twenty-four hours there are 200 death-beds in New York; had the death-rate of twenty years ago persisted there would be 130 more!

ACCORDING to the report for 1913, the Rhodesia Museum, Bulawayo, is arranging an economic section for the display of the natural products of the country, which it is hoped will aid in the development of the latter. Thanks to an annual grant voted by the British South Africa Company, the staff has commenced to collect specimens for exhibition which will represent the raw products of the country and the preparation they have to undergo before being converted into finished commercial products. Despite an insufficiency of funds, of floor-space, and of exhibition-cases, certain departments of the museum—notably the herbarium—continue to make satisfactory progress.

IN the annual report of the Field Museum of Natural History, Chicago, for the past year it is stated that the energies of the staff have been largely occupied in preparing exhibition material for the new building. The result of this has been a crowding of cases in some of the exhibition galleries "to a degree that must be confusing to visitors, as it certainly is most unsatisfactory to the management." So great, indeed, is the pressure, that it is suggested it will be necessary

Skeleton of the South American Marsupial Cænolestes, believed to be the only one on exhibition. About one-third natural size. From the Report of the Field Museum

to close some of the public galleries and use them as storage rooms. An important item in the museum's progress was the return of an expedition, under Dr. Lewis, which for three years has been collecting ethnological subjects in the islands of the South Pacific, and has brought back a vast series of specimens. An interesting feature of the report is a figure (herewith reproduced) of the skeleton of the South American marsupial, Cænolestes, the sole survivor of the Tertiary family Epanorthidæ. This skeleton is claimed to be at present unique, no other museum, it is believed, having a specimen.

IN the report of the U.S. National Museum, Washington, for 1913, after reference to the great labour involved in the installation of the cases and specimens in the new buildings, and a notice of the work that has been accomplished in the anthropological section, attention is directed to the exhibits illustrative of the geographical distribution of animals—a subject to which special attention is being devoted in the public galleries. The chief faunas illustrated are those of North America and the Palæarctic, Oriental, and Ethiopean regions, a smaller amount of space being assigned to those of South America and Australasia. Most striking of all appears to be the exhibit of groups of African big game, these including a family of lions, another of Cooke's hartebeest, and a third of the Lado white rhinoceros, as well as of the African buffalo (incorrectly termed the "water-buffalo") and Grévy's zebra.

IN No. 11 of the *Bull. Ac. Sci., St. Petersburg*, for 1914, Dr. N. Nasonov proposes the name *Ovis severtzovi* for the wild sheep inhabiting the low range on the Turkestan frontier of Bokhara, variously known as the Karatau, Nuratyntau, Nuratanyntu, Nurata, Nuratau, or Nuratadagh. In the *Field* for 1909 this sheep was identified by Mr. Douglas Carruthers with Severtzow's *O. nigrimontana*, typically from the other Karatau, in the province of Syr Daria, on the right bank of the river of that name, eastward of the city of Turkestan; but Dr. Nasonov, from the evidence of specimens in the St. Petersburg Museum, is enabled to show that the two are distinct. *O. severtzovi*, which is the smaller, approximates, as pointed out by Mr. Carruthers, to the *O. vignei* (*arkar*) group, especially in the presence of a distinct, although narrow, throat-ruff, while *O. nigrimontana* comes nearer to the *poli* type. In referring to it as *O. poloi nigrimontana*, Dr. Nasonov alters Blyth's name *poli*, which is the genitive of polus, the Latinised form of polos. It may be added that, owing to a confusion between the two "Karataus," Mr. Lydekker has given Bokhara as the typical locality of *O. nigrimontana*.

FROM the Maine Agricultural Experiment Station two important studies on reproduction in domestic fowls have lately been issued. Maynie R. Curtis writes on double and triple-yolked eggs (*Biol. Bulletin*, vol. xxvi., No. 2, 1914). Some young pullets are found to produce double-yolked eggs when they first begin to lay, about 20 per cent. of those which lay before the age of seven months producing among their first eggs one or more with two yolks. Mature birds rarely produce these abnormal eggs, and no single bird under observation ever produced more than a few of them. Of triple-yolked eggs only three were laid in six years among more than three thousand birds; in each case the abnormality was one of a young pullet's first progeny. Various disturbances of the normal processes of egg production may bring two yolks together in the oviduct, and double-yolked eggs do not always represent simultaneous ovulations. The other paper is by Alice M. Boring and Raymond Pearl (*Journ. Exp. Zool.*, vol. xvi., No. 1, 1914), and deals with the nature of the "odd chromosome," described by M. F. Guyer in 1909 in the spermatogenesis of the chick. The existence of such a chromosome would suggest that the male is heterozygous for sex, whereas crossing experiments with breeds of domestic poultry and other birds that show sex-limited characters seem to indicate clearly that the female and not the male is heterozygous. Guyer worked with "Langshan" birds, Boring and Pearl have used "Barred Plymouth Rocks." They find in about 12 per cent. of the first spermatocytes, and 3 per cent. of the second spermatocytes, a piece of chromatin like that described as an "odd chromosome" by Guyer. As the structure is present in spermatocytes of both orders, and varies in shape, size, and number, the authors conclude that it cannot be an "odd chromosome" at all.

IN the *Izvestiya* of the Eastern Siberia branch of the Russian Geographical Society, Mr. M. Nikitin gives some results of the levelling operations carried out by Captain Kremlyakof in connection with the Siberian railway. The mean height of Lake Baikal is calculated to be 1485 ft. Other figures are Irkutsk (railway station), 1410 ft.; Mysovaya, 1514 ft.; Verkhneudinsk, 1763 ft.; Petrovski Zavot, 2627 ft.; Chita, 2150 ft.

THE geology of the islands in the Arctic Ocean, discovered by Captain Vilkitski (vol. xcii., p. 456), is described by Messrs. Baklund and Tolmachef in the Bulletin of the Imperial Academy of Sciences of St. Petersburg (No. 10, 1914). The island General Vilkitski is connected as regards its geological structure with the adjacent New Siberia islands, while those lying off the Taimyr peninsula are similar to the latter. Thus the specimens collected on Emperor Nikolas II. Land are of rocks found on Cape Cheliuskin, and also found by the expedition on the eastern coast of the Taimyr peninsula. Emperor Nikolas Land is therefore a northern continuation of the peninsula, now separated from it by a strait some tens of miles in breadth, in which lies the island Tsesarevich Alexis, built up of detritus from the Taimyr peninsula, especially from the western coast. The Emperor Nikolas Land is, however, known at present only at two points, and future investigations may materially modify present conclusions.

AN interesting article by Dr. A. E. Douglass, on a method of estimating rainfall by the growth of trees, was published in the May number of the Bulletin of the American Geographical Society. The author reasons that the rings of a tree measure its food supply, and that the latter, especially in the dry climate of the plateau of Arizona, which is dealt with, depends largely upon moisture. With the cooperation of other men of science curves of tree growth were prepared, and the connection with rainfall and possibly with astronomical phenomena was investigated. Dr. Douglass states that the method of measurement consisted of determining the thickness of each annual ring in millimetres along some typical radial line. The average age of the trees (yellow pine) was 348 years, with two extending to 520 years. The total number of individual measurements exceeded ten thousand. For any detailed description of the laborious investigation we must refer to the original article; the conclusion states that the purpose of the work has been accomplished, a connection has been found between tree growth and rainfall, as well as indications of association between meteorological and astronomical phenomena. With regard to the latter point due reference is made to investigations at Eberswalde (Germany) and elsewhere in connection with tree growth.

A COPY has reached us of the report for 1912–13 of the chief of the Weather Bureau of the U.S. Department of Agriculture. Referring to the aerial investigations in charge of Prof. W. R. Blair, the report states that the temperature distribution up to about the 1·5 km. level shows the same type of diurnal variation as is observed at the earth's surface. In the region near the 1·5 km. level a second maximum of temperature appears after midnight, while the 3 p.m. to 4 p.m. maximum practically disappears. Above this region the 2 a.m. to 4 a.m. maximum is the principal, the minimum for the day being found at 2 p.m. to 3 p.m. or earlier. There is some variation with the season in the times given for these maxima and minima. As regards the solar radiation investigations of which Prof. H. H. Kimball has charge, the report says the most interesting feature of the observational data for the year is the marked decrease in solar radiation intensities and in the polarisation of skylight, which was noticed first at Mount Weather in the observations of June 12, 1912. The intensity of the direct solar radiation with the sun 60° from the zenith averaged only about 85 per cent. of its normal value during the second half of 1912, and but little more than this during the first half of 1913. The polarisation of skylight averaged about 66 per cent. of its normal value during the second half of 1912, and about 75 per cent. of the normal during the first half of 1913.

IN the *Verhandlungen* of the German Physical Society for June 15, Dr. E. Goldstein describes in detail some light effects he first noticed in 1902 about a kathode freely suspended in a gas through which an electric discharge was passing. In addition to the canal rays, which are generally observed by allowing them to pass to the back of the kathode through a small hole in it, Goldstein shows that from a kathode consisting of two regular polygonal plates close together, bundles of canal rays are projected outwards from the middle of the sides or from the angles of the polygons according as they have an even or an odd number of sides. By taking circular electrodes from which strips have been cut at the edges or into the edges of which notches of various shapes have been cut, he is able to show that these outwardly directed canal rays are due to the focussing of inwardly directed canal rays within the two sheets of the kathode and to the strong ionisation produced at the focus. Their direction is that of the minimum path from the focus to the edge of the kathode.

THE Bulletin of the Imperial Society of Naturalists of Moscow for 1913 contains a paper of 225 pages by Dr. Ernst Leyst, entitled "Variations and Disturbances of Earth-magnetism." The first part deals with the results obtained when the arithmetic mean is replaced by the "central value," defined as that having as many positive departures from it as negative. The latter part of the paper discusses disturbance phenomena, mainly at Pavlovsk. Dr. Leyst treats as disturbed all days having a range not less than twice as large as that of the average day of the average year. The qualifying ranges thus obtained were 29·0′ in declination, 130γ in horizontal force and

70γ in vertical force. Attainment of the limit in any one of the three elements qualifies. Taking the twenty-four years, 1885 to 1908, at Pavlovsk, the greatest and least annual numbers of disturbed days were respectively 90 in 1892 and 6 in 1901. The months of greatest and least disturbance were respectively March, with an average of 4·9 days, and December, with an average of 2·2. There is an interesting comparison of the diurnal variation on the days immediately before and after selected disturbed days, the disturbed days themselves, and normal days. The paper is full of tables of numerical results representing much labour, as to the significance of some of which opinions are likely to differ. Dr. Leyst apparently adheres to an earlier conclusion of his that the secular change of declination is least during sunspot minimum years. This conclusion is scarcely likely to obtain general acceptance in view of the remarkably large secular variation of declination observed in western Europe since 1910.

The artificial preparation of an important plant constituent which has hitherto resisted chemical synthesis has just been accomplished by Messrs. H. Wieland and R. S. Wishart (*Berichte,* 1914, p. 2082) in the case of inositol. This substance, it is shown, can be readily obtained by reducing hexahydroxybenzene with hydrogen gas in presence of finely-divided palladium black. As the potassium compound of hexahydroxybenzene is formed by the action of carbon monoxide on potassium, a simple method exists for the direct synthesis of inositol from its elements The artificially obtained substance is identical in all respects with the naturally occurring compound.

The association of vanadium with petroleum and asphalt and its relationship to the formation of asphalt deposits, is dealt with by Messrs. R. M. Bird and W. S. Calcott in a paper published in the Bulletin of the Philosophical Society, University of Virginia. From the experiments recorded in this communication it is suggested that the Peruvian deposits of vanadium sulphide and oxide, which occur in alternate layers with asphalt, are probably formed in the following way. Vanadates in solution in ground water come into contact with oils bearing hydrogen sulphide, and thus yield vanadium sulphide, which may travel with the oil and be deposited by meeting with carbon dioxide, In presence of atmospheric oxygen the vanadium sulphide acts as an oxygen carrier, and converts the accumulating mass of oil into asphalt. That this latter change may rapidly occur is shown by actual experiment in presence of oxygen, but no "asphalting" of mineral oil occurs when oxygen is excluded. The formation of asphalt thus appears to be essentially an oxidation process in which active catalytic agents, such as vanadium, play a part.

The Carnegie Institution of Washington has now added to its series of "Papers of the Department of Historical Research," which are being produced under the editorship of Mr. J. Franklin Jameson, a volume of 642 pages entitled "Guide to the Materials in London Archives for the History of the United States since 1783," by Dr. C. O. Paullin, of the Carnegie Institution, and Prof. F. L. Paxson, of the University of Wisconsin. The book extends, in respect of almost all portions of the British archives, from 1783 to 1860. The scope of the volume is confined to the Public Record Office, the archives of the offices of the Central Government of Great Britain in London, and the manuscript department of the British Museum. The book is one of a series of guides to the materials for American history in foreign archives which have been published or are to be published by the Carnegie Institution. Volumes relating to the materials in the archives of Canada, Mexico, Cuba, Spain, Italy, and Germany have been issued already, and noticed in these columns from time to time. The group concerned with English archives consists of four volumes, of which the present is in logical order the fourth.

In the *Bulletin de la Société d'Encouragement* (vol. cxxi., p. 425) Prof. Camille Matignon gives, under the title, "A New Industry—The Rational Utilisation of Distillery Vinasses," an interesting account of the Effront process for the recovery of the nitrogen and potash values of the waste liquors remaining after distillation of the alcohol from the fermented liquors prepared from grain or the molasses of the beetroot-sugar industry. The Effront process has been working experimentally on the large scale during the past three years, and many of the practical difficulties have already been overcome. It consists in subjecting the vinasses to fermentation by a butyric organism isolated from soil. The fermentation takes place in distinctly alkaline solution and converts the whole of the nitrogen of amino-acids or amides, such as glycine, asparagine, or glutamic acid, completely into ammonia; the betaïne is transformed into trimethylamine, and the residues of the acids into free fatty acids, such as acetic acid and its homologues, succinic acid, malic and tartaric acids. Processes have been devised for separating the ammonia and the trimethylamine, the latter of which is decomposed by heating at 1000° into methane and hydrogen cyanide; the methane is used as a source of energy, and the hydrogen cyanide is absorbed as sodium cyanide. The experimental factory already produces 6 tons of acetic acid and 1 ton of butyric acid each day; the latter acid, a new technical product, has already found application in tanneries, and at the moment the demand exceeds the supply.

A complete set of catalogues of the Société Genevoise pour la Construction d'Instruments de Physique et de Mécanique has been received from Mr. O. Paul Monckton, of 87 Victoria Street, Westminster, who is the sole agent for Great Britain and the Colonies. The seven lists are beautifully produced, excellently illustrated, and arranged in a manner which makes reference to them easy. Among the subjects dealt with in different catalogues may be mentioned: exact measuring machines for industrial and laboratory use, general measuring instruments, including kathetometers, micrometers, dynamometers, goniometers, and so on; apparatus for the study of general physics and mechanics; microscopes, spectrometers; and electromagnets.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—The following is a continuation of the ephemeris of Delavan's comet (1913*f*) as given by Dr. G. van Biesbroeck in *Astronomische Nachrichten*, No. 4739:—

	R.A. (true) h. m. s.	Decl. (true) ° ′ ″	Mag.
July 23	5 39 42	+36 2 16	6·6
24	42 19	21 24	
25	45 0	40 39	
26	47 43	37 0 2	6·5
27	50 29	19 32	
28	53 18	39 9	
29	56 10	58 54	
30	5 59 6	+38 18 44	6·3

OBSERVATIONS OF HALLEY'S COMET.—The June number of the *Astrophysical Journal* (vol. xxxix., No. 5) contains a communication by Prof. E. E. Barnard on the visual observations of Halley's comet in 1910, made by him at the Yerkes Observatory. Numerous fine illustrations from photographs accompany the text. In the first instance he points out that Halley's comet at its return in 1910, though a brilliant and interesting object to the naked eye, especially in May, was nevertheless a disappointment when considered from a photographic point of view. Photographically its light was relatively slow, and there were few or no remarkable phenomena. After mentioning the probable encounter of the southern branch of the tail with the earth on or about May 18 or 19, he directs attention to the presence of the double tail overlooked by observers in the northern hemisphere. Observations made with the 40-in. are next described, and special attention is directed to the long mass in the tail receding from the head. The appearance is beautifully shown in three photographs taken in June at Yerkes, Honolulu, and Beirut. Prof. Barnard then brings together all his visual observations made from the first to the last appearance of the comet, for he was determined, as he says, "to prepare as faithful an account as possible of its appearance to the naked eye for the benefit of observers at future returns," since he was much disappointed "at the meagreness of the records" at its appearance in 1835, when he was seeking published information concerning its appearance.

REPORTS OF INDIAN OBSERVATORIES.—A recent publication gives the report of the Director-General of Observatories of the Observatories of Kodaikanal, Madras, Bombay, and Alibag for the year 1913, and this includes the reports of the individual directors. As regards Kodaikanal, Dr. G. T. Walker states that the output of this observatory is at present limited by the amount of measuring that can be accomplished, and this is being altered by the training of the new assistants. He also makes the important statement that when Mr. Evershed was in Srinagar in Kashmir in 1913 he found that the air there was extraordinarily good for solar and stellar work, and it is now being considered whether the observatory at Kodaikanal should be totally or partially removed there. The only drawback, apart from the question of cost, is the chief disadvantage of the small amount of sunshine in January and February, the months when other solar observatories are labouring under disadvantages, while at Kodaikanal the seeing is at its best. As the chief astronomical work at the Madras Observatory is the determination and distribution of time this will now be closely associated with the distribution of the time by the new powerful radio-station that is to be erected in India, forming a link between Aden and Singapore. The idea is for the radio-station to be equipped with two good clocks, and to send special time signals to Madras, so that the clock-errors can be determined and wired back to the radio-station previous to the distribution of the general time signals. The usual routine observations were carried out at Bombay (Colaba and Alibag), but damp, and white ants, caused great anxiety regarding the walls for the self-registering variation instruments at Alibag.

RECENT PHYSICAL INVESTIGATIONS IN THE NORTH ATLANTIC OCEAN.

TWO recent publications summarise more or less thoroughly our present knowledge of the physical features of the waters of the North Atlantic Ocean. One gives an account by Dr. Fridtjof Nansen of recent researches carried on especially by the Norwegians, and the other, by Prof. Otto Pettersson and Commander C. F. Drechsel, urges united international effort to carry on further research in these waters.[1]

Dr. Nansen gives a detailed account of oceanographical investigations in the north-eastern part of the North Atlantic Ocean made in July, 1910, on board the Norwegian gunboat, *Frithjof*, under the command of Capt. Caspar S. Erlandsen.

Dr. B. Helland-Hansen and Dr. Nansen had noted that "variations in the temperature of the Atlantic current from one year to another, were followed by corresponding variations in the winter climate of Norway, and also by variations in the fisheries of the North Sea and at Lofoten, etc." The question was as to whether the observed annual variations in the volume and temperature of what Dr. Nansen terms the Norwegian Atlantic current "were due to variations in the physical conditions of the North Atlantic, south of the Wyville Thomson Ridge and the Faeroe-Iceland Ridge, or to other causes, *e.g.* variations in the East Icelandic Arctic current."

The cruise of the *Frithjof* lasted fifteen days, leaving Belfast on July 6, 1910, Seydis Fiord, Iceland, was reached on July 13, and Bergen on July 21. On the basis of these observations, which are duly tabulated, five sections have been drawn. These observations were taken with carefully selected instruments supplied by Dr. Nansen. The automatic insulating water-bottle seems to have been at times untrustworthy, but otherwise the instruments gave satisfactory results. Dr. Nansen suggests that it is very desirable always to use two thermometers for the determination of deep-sea temperatures. All water samples were collected in rubber washered bottles with lever fastening, holding 200 c.c. and 500 c.c. each. Titrations were carried out by Dr. Helland-Hansen, or under his supervision at Bergen. The titrations were checked in the ordinary way by "normal water" from the International Bureau in Copenhagen.

The observations made resulted in showing that vertical convection currents reached depths of 600 metres. Dr. Nansen is of opinion that this vertical circulation is of great importance in heating the atmosphere of this region during the winter. It was estimated that direct absorption of heat from the sun's rays may be felt to a depth of 100 metres.

In the region traversed by the *Frithjof* precipitation is greater than evaporation, not only in winter, but evidently also on the average during summer. From the observations of Mr. Donald J. Mathews, as well as those of the *Frithjof*, it appears that in this region the sea-surface has its maximum salinity at the end of the winter or in the spring, and its minimum salinity at the end of the summer or in the autumn. Prof. Martin Knudsen has found similar seasonal variations. Knudsen suggests that the most probable

[1] (1) "The Waters of the North-eastern North Atlantic." By Fridtjof Nansen.
(2) "Mémoire sur des Recherches dans l'Atlantique avec programme By O. Pettersson and C. F. Drechsel.

explanation of this periodical variation would be, that the Gulf Stream has a maximum velocity in the spring and a minimum period in the autumn, but Dr. Nansen is of opinion, that it is self-evident that the dilution of the surface water due to the precipitation during the summer in connection with vertical circulation during the winter, gives the simplest explanation of this seasonal variation.

Krummel has termed that part of the Gulf Stream passing Section I. of the *Frithjof* cruise across the Rockall Channel and the Rockall Bank, the "Irish current." Its waters are easily distinguished by the comparatively high salinities and temperature. "The section proves that the greater part of the water-masses, carried north-eastwards by the Irish current, passes through the Rockall Channel, between the continental shelf off Iceland and the Rockall Bank, while only a small portion of the water with the highest salinities (above 35·30 per cent.) occurs west of the Rockall Bank, and seems to have no distinct northward movement." It is obvious that it is a continuation of this current through the Rockall Channel which flows through the Faeroe-Shetland Channel. Amundsen's observations in June and July also bear this out. These important recent Norwegian observations are confirmatory of the *Porcupine* observations of 1869. Dr. Nansen states that the Scottish series of salinity observations in August, 1910, from the Faeroe-Shetland Channel, taken in the same month, have often some "inaccurate values," and may be too high. Authority for this statement would have been desirable and also for the further criticism of the Scottish stations 19 C and 14 A of May, 1910, for it does not always follow that even "very great irregularities" indicate erroneous observations, however inconvenient they may be to our theories.

It is a fashion of the present day to attempt to obliterate the general term "Gulf Stream," and Dr. Nansen follows this plan, but the fact remains that there is a continuous movement of the surface waters of the sea which is capable of carrying an object from the West Indies to Spitsbergen, and "Gulf Stream" remains a useful name for this continuous flow of water, called by recent investigators by different names in different regions. There is no doubt that the "Gulf Stream" is due to many factors, and not solely due to that initial impulse the waters have as they leave the Gulf of Mexico, but why not continue to use this useful term which defines this remarkable series of phenomena as a whole, at the same time recognising the different factors that cause it to exist. The statement that the Gulf Stream off western British coasts "is to a very great extent a current coming from the south, along the continental slope west of Europe," is by no means new, and does not obliterate the main phenomenon referred to. The point of interest in the Norwegian observations is not that the current described by Rennell in 1793 flows northward, but that this current flows at quite a considerable depth, and not only at the surface, a very important addition to our knowledge of the Rennell current; also, that it seems to consist very largely of Mediterranean water.

But in this connection, it should not be forgotten that about twenty years ago Buchan pointed out that the influence of the warm undercurrent from the Mediterranean is clearly apparent in the Atlantic Ocean at a depth of 500 fathoms, and that "beyond this depth, its great influence is felt over nearly the whole breadth of the Atlantic to at least about 1000 fathoms."[2]

It is a sweeping statement to say that "most leading oceanographers have taken it for granted that the currents of the surface layers were practically the same, at least as to direction, as those of the deeper strata," and that they study chiefly surface observations, and think "that all oceanic currents are chiefly, if not entirely, created by the winds," that they do not understand the effect of the earth's rotation, and have not appreciated the value of vertical sections of the ocean to elucidate horizontal movements of the water." Carpenter, before the *Challenger* sailed, strongly advocated the doctrine of vertical ocean circulation sustained by opposition of temperature, and while Buchanan used vertical sections so early as 1877[3] in a paper entitled "Distribution of Salt in the Ocean as Indicated by the Specific Gravity of its Waters," where a vertical section through the Atlantic Ocean from 30° N. to 30° S. is given. Subsequently Buchanan used vertical sections in his report on the specific gravity of ocean water, which was published in 1884 in vol. i. (Chemistry and Physics) in the *Challenger* reports. In the same volume there appears a "Report on Deep Sea Temperature Observations," obtained by the officers of H.M.S. *Challenger,* where there are 258 plates all representing vertical sections. In fact, no efficient oceanographer considers these physical questions without the use of vertical sections; neither would he assert that all oceanic currents are entirely created by wind, nor will he deny that they are very largely created by wind. Wind, specific gravity, temperature, and rotation of the earth are all among the many factors which influence oceanic circulation, both vertical and horizontal, and none of these should be considered apart from the others if satisfactory results are to be arrived at.

Dr. Nansen considers it difficult to draw any certain conclusions as regards the annual variations in the temperature of the Irish current owing to insufficient material of observations from previous years. The observations seem, however, to prove that there have been no great variations in those few years.

The temperature of the Irmiger current to the west of Iceland was warmest in 1896, less warm in 1895, 1904, and 1903. There are also similar variations in the sea south of Iceland, but the conclusions are less trustworthy, because the sea is shallower and the frequent variations in depth may have a great influence upon temperature even at short distances. These variations Dr. Nansen considers have an effect on the climate of Iceland.

There appear to be continually very great changes in the position of the waters of the Faeroe-Shetland channel. Drs. Helland-Hansen and Nansen conclude that great sub-surface boundary waves probably occur in the sea, and that "waves" seen in the many vertical sections of the Norwegian Sea may be due partly to such boundary waves, partly to horizontal vortex movements.

The paper is a useful summary of all the observations taken in these waters, besides those of the *Frithjof* expedition.

Prof. Otto Pettersson and Commander C. F. Drechsel urge systematic hydrographical and biological investigations of the whole of the Atlantic Ocean as one of the most important scientific and practical tasks of the future. As a beginning, synoptical reconnaissances at different seasons down to a depth of 1000 metres, are recommended. The programme is drawn up in two heads :—(1) Investigation of coastal seas; (2) Transatlantic investigation cruises. Simultaneous quarterly cruises are recommended, because this method of investigation has been recommended by recent geographical congresses, and has served as a basis for the investigation of northern seas and the Adriatic, for obtaining a comprehensive view of the

[2] Report on Ocean Circulation. By Dr. Alex. Buchan. (*Challenger* Reports, 1895.)

[3] Proc. R. G. S., March 12, 1877.

conditions of the Atlantic in winter and summer. It is pointed out that the opening of the Panama Canal in 1915 gives a great opportunity for the different countries sending vessels to represent them of taking simultaneously an extensive series of observations from Europe to America. It is to be hoped that the different Governments will be induced to take part in carrying out this important work, and thus mark the union of the Atlantic and Pacific Oceans by a unique effort to add to our knowledge of the sea.

W. S. B.

ORNITHOLOGICAL NOTES.

THE spring number (vol. vi., No. 1) of *Bird Notes and News* is devoted exclusively to the Plumage Bill, and its effect, if passed on workers in the feather-trade in this and other countries. It includes a good report of the debate which took place when the Bill came up for second reading, together with the division-list on that occasion. Individual opinions from various persons on the matter, as well as the views of scientific bodies, are also quoted. It is added that the vast number of bird-skins (many of them representing rare species of the paradise group) offered for sale at auctions in London affords fresh testimony of the need for prohibitive legislation.

The March-April number of *Bird-Lore* records some of the steps which are being taken to enforce the recent regulations of the U.S. Federal Government with regard to the slaughter of game-birds and their transport from one State to another, special attention being directed to the seizures of long guns carrying half a pound of powder and a pound of shot. One of the illustrations shows the costly monument recently erected in Salt Lake City to commemorate the gulls which saved the crops of the first Mormon settlers by devouring the grasshoppers by which they were being devastated. As the gulls had "the time of their lives," it is not apparent why a monument was required.

The roseate spoonbill (*Ajaia ajaja*) of tropical America forms the subject of an article, illustrated by a coloured plate, in the issue of *Bird-Lore* for May and June. So long ago as 1858 it appears that the pink curlews, as they are locally called, on Pelican Island, Florida, were the prey of plume-hunters, some of whom are reported to have killed upwards of sixty a day, and from that time to this these beautiful birds have been persecuted by every man who could lay his hands on a shot-gun. Now, however, the National Association of Audubon Societies has succeeded in establishing reservations in Florida, where the spoonbills may breed unmolested.

An article on the stilt and another on the moorhen are among the more noteworthy contents of the April number of *Wild Life*, the former an account of the author's success in photographing such a rare and shy species, and the latter for the beauty of the pictures.

In view of the probable extermination of the species at no very distant date, owing to the introduction of foxes, an article by Mr. J. G. O'Donoghue, in the *Victorian Naturalist* for May, 1914, on the habits of the Victorian lyre-bird has a claim to more than ordinary interest.

A paper by Prof. J. E. Duerden, published in the Agricultural Journal of the Union of South Africa for October, 1913, deals with the mode of development of the feathers of ostriches, and the entire absence of cruelty to the birds in clipping them, at the proper season, for market.

Bird-lovers in South Africa owe a debt of gratitude to Mr. Alwin Haagner for the issue of the first part of a concise descriptive list of South African birds, published as No. 3 of the bulletin series of the publications of the South African Ornithologists' Union. This part includes the ostrich, of which the South African representative is regarded as a distinct species, the penguins, divers, petrels, gulls, and terns, cormorant tribe, ducks and geese, and the plover group.

An article by H. W. Henshaw on birds commonly to be seen in town or country in the United States, illustrated by sixty-four small portraits in colour, forms one of the most attractive features of the May number of the *National Geographic Magazine*. Of more general interest are two pictures, taken by Mr. R. E. Croker, representing a colony of something like 100,000 pelicans on the easternmost island of the Lobos de Afueva group, off Peru. Unhappily this vast colony, which had been unmolested for several years, has not escaped the attention of the guano-seekers, and, on a second visit, Mr. Croker found scarcely any pelicans near the old colony. "It is one of the tragedies," he remarks, "of the guano-industry that this important bird has received so little consideration."

It has been asserted that the Australian short-tailed petrel, or "mutton-bird" (*Puffinus brevicaudus*), takes no fewer than eight weeks to incubate its eggs. According, however, to a a note by Mr. J. Gabriel in the April number of the *Victorian Naturalist*, one out of a clutch of eight eggs placed under a domesticated hen was hatched in forty-six days, the remainder of the clutch being either broken or infertile.

In his annual summary of bird-life in Norfolk, published in the May number of the *Zoologist*, Mr. J. H. Gurney records that spoonbills were seen last year at Breydon Broad at intervals from May 1 to August 16. As the result of a comparison of previous observations, it appears that these birds generally reach Norfolk during the prevalence of north-east winds, which are probably unfavourable to their northward migration.

As the result of an exhaustive study of the extensive series of cuckoos' eggs and the foster-clutches with which they were associated (some three hundred in number) included in the fine collection of eggs recently presented by Mr. R. H. Fenton to Aberdeen University, Dr. J. Rennie, in an article published in vol. xix., No. 5, of the Proceedings of the Royal Physical Society of Edinburgh, arrives at the conclusion that the theory of the existence of different strains of cuckoos, severally characterised by laying eggs of distinctive types of colouring, will not hold good. According to this theory, as enunciated by the late Prof. A. Newton, one of these strains—"hedge-sparrow cuckoos"—generally lays eggs assimilating in colour to those of hedge-sparrows in the nests of that species; while "wagtail-cuckoos" act in an analogous manner in the case of the species from which they take their name, and so on. In the opinion of the author, the clutches in the Fenton collection lend no support to the theory of the existence of such strains, at all events in this country. This conclusion, it is urged, receives further support from the polyandrous habit of female cuckoos, as individual hens may mate at one time with a cock of the "hedge-sparrow," and at another with one of the "wagtail" strain. The author, it may be added, alludes to these supposed strains as "subspecies," which is certainly a misuse of that term.

The remarkable changes in the length and colouring of the beak and in the colour of the plumage undergone by the white ibis (*Guira alba*) during its development from the nestling to the adult stage are graphically illustrated in a coloured plate accompanying an article by C. W. Beebe, forming No. 12 of the first volume of *Zoologica* (New York Zool. Soc.). In the nestling the short beak has dark barrings, and the head and neck are darker than the back; later on the head and neck become lighter than the back, but by the time the bird has become adolescent the whole body is almost completely white, the head and neck alone being flecked with brown; the beak has increased inordinately in length, with the assumption of a pink tinge. Finally, in the case of the cock, the whole plumage becomes pure white, while the long, sickle-shaped beak, together with a large bare area at its base and in the orbital region, has become brilliant crimson. Although the article is headed "Notes on the ontogeny of the white ibis," no clue to the real meaning of these changes in form and colouring is suggested.

In the June number (vol. viii., p. 2) of *British Birds*, Messrs. Hans Stadler and Cornel Schmidt direct attention to the general neglect of the study and interpretation of the notes of birds in Great Britain, as compared with what is being done in Germany. Apart from the lack of musical appreciation or musical education, three main difficulties—namely, the determination of the pitch, the admixture of non-musical sounds with the notes of birds, and the "colouring" of these notes, which is often widely different from that of the human voice or ordinary musical instruments—have hitherto materially hindered this branch of study. The authors now demonstrate how these difficulties may be overcome.

Prof. R. Ridgway is to be congratulated on the publication (after an interval of three years since the appearance of its predecessor) of the sixth volume (Bull. U.S. Nat. Mus., No. 50) of his invaluable monograph of the birds of North and Middle America. This volume not only completes the Passerines, but also includes the Picarians and related groups, as well as the owls. In the latter group it is a matter for regret to see the barn-owls figuring as Tyto, while Strix, following the classification of the late Prof. Newton, is transferred to the tawny owl. This is eminently a case for the intervention of the "fiat" of the International Commission on Zoological Nomenclature. In most other respects Prof. Ridgway's latest effort is worthy of high commendation.

In a handbook and guide to the British birds exhibited in the Lord Derby Museum, Liverpool, it is claimed that a coot mounted amid an imitation of its natural surroundings in 1865 was the first exhibit of this kind shown in this country, if not in the world. Groups of all species nesting in the Liverpool district, together with a few others, are now exhibited in the museum, and of a dozen of these groups photographs are reproduced in the guide. The nomenclature is much the same as in Newton's "Yarrell," but it seems illogical to use the name *Lagopus lagopus* for the willow-grouse, and yet to retain *Perdix cinerea* for the partridge.

We have to acknowledge the receipt of a copy of a paper from the March number of the *Ottawa Naturalist*, by Dr. C. G Hewitt, on local bird-protection; also of a catalogue of more than 1400 publications on ornithology offered for sale by Messrs. John Weldon, 38 Great Queen Street, London, W.C. R. L.

TERRESTRIAL MAGNETISM.

THE present activity of the department of terrestrial magnetism of the Carnegie Institution of Washington and the largeness of its future aims are alike illustrated in the annual report for 1913, by the director, Dr. L. A. Bauer, and in a "progress report" which he contributes to the latest (March) number of *Terrestrial Magnetism*. The department, which has lately entered on its eleventh year, has under construction new buildings at an estimated cost, including site and equipment, of about 25,000*l*. The main structure, which is already completed, is shown in the accompanying figure. It has a length of 102 ft., a width of 52 ft., and from basement to roof a height of 62 ft. Besides ample accommodation for observers and computers, engaged on the reduction and discussion of observations, it includes several laboratories, an instrument-maker's shop, and store places for instruments. A detached building for tests and researches requiring a non-magnetic environment will shortly be completed.

Of late years the energies of the department have been mainly devoted to a magnetic survey of the earth, including the oceans. In the financial year which ended on October 31, 1913, the expenditure of the department, apart from building, reached 22,000*l*. In addition to important work at sea by the surveying vessel *Carnegie*, it had land observations in progress in many quarters of the world. One party observed at seventy-two stations in the Sahara between Algiers and Timbuctoo. Another party in Australia observed in Queensland, Victoria, and New South Wales. A

Main building of the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

third journeyed some 2000 miles by canoe in remote parts of Canada. South America engaged three parties, observing in Peru, Bolivia, Chile, Venezuela, British Guiana, Brazil, Argentina, Paraguay, and Uruguay. It is expected that by 1915 data will have been obtained adequate for the construction of satisfactory magnetic charts for the epoch January 1, 1910, extending from 50° N. to 50° S. latitude.

The work of the department is not confined to terrestrial magnetism. In future more attention is to be given than in the past to atmospheric electricity. Dr. W. F. G. Swann, late of Sheffield University, has been engaged as chief physicist, and is devoting special attention to this subject. One of the objects to which much attention continues to be devoted is the improvement of magnetic instruments. Dr. Bauer's article in *Terrestrial Magnetism* is largely devoted to a discussion of the degree of accuracy reached with existing types of magnetometers, and the prospects of obtaining superior results with electrical methods of measuring the direction and intensity of the earth's field. While recognising the high accuracy now attained in electrical measurements, he concludes that much experiment will be necessary before we can hope to introduce electrical methods with advantage in place of magnetometers, more especially for field work.

C. CHREE.

TIMBER FOR RAILWAY SLEEPERS.[1]

A VALUABLE contribution to the literature on Indian timber trees, containing the preliminary results of experiments and inquiries initiated at the Dehra Dun Institute some three years ago, has lately been issued. Research work on timber from an economic point of view is necessarily a slow business, and years must elapse before final conclusions can be reached, but the information already obtained during this inquiry indicates clearly that the final results are likely to prove of great economic value.

The memoir is divided into five sections, which deal in turn with the physical and mechanical properties of Sál timber, its durability, its uses, as well as those of the minor products of the tree, the quality of the charcoal and fuel, and the yield and prices. One point of special interest will illustrate the nature of the work in progress and its prime importance. Sál is one of the chief timbers employed for railway sleepers, and in these days it is surprising to find that the majority of the sleepers on Indian lines undergo no previous treatment with preservatives—all the more so, when one knows how abundant are the insect and fungus pests, and how rapid their powers of growth and reproduction. This apparent indifference on the part of Indian railways to the great economy effected in other countries by treatment of the sleepers is not easy to explain. It may in part be due to the methods used in temperate climates having proved less satisfactory when the sleepers are exposed to the hot sun of India. But it is also probably due to the natural durability of sál, teak, deodar, pyinkado, and other woods of this class, which last so long in the natural condition, that any extension of their lives by treatment with preservatives would probably result in the resistance to decay becoming greater than the resistance to mechanical wear and tear, and in this event a large proportion of the cost of treatment would be money thrown away.

But it is open to question whether such valuable woods should be employed for sleepers at all. During the past forty years it has been pointed out again and again that India possesses several species of lower-grade timbers which appear to possess all the necessary qualifications for sleepers. Their natural durability is low, but this defect can be overcome by artificial methods. The fact brought out at the end of this memoir, that India is now beginning to import Jarrah sleepers from Australia, shows the urgent need for testing these lower-grade timbers to see whether by treatment they can be rendered equally as serviceable as sál, teak, deodar, etc. This question is being investigated at Dehra Dun on a practical scale, and if any of these timbers can be brought into general use the economic value of the work will be enormous. India will not only be enabled to continue the production of her own sleeper requirements, and to employ timbers for the purpose which have no special outlet in other directions, but she will also economise her more valuable forests of sál alone to the extent of some two and a half million cubic feet per annum, to say nothing of teak, deodar, pyinkado, and the jarrah from Australia.

Although there is at present little market for sál outside India, the steady diminution of the world's timber supply renders it certain that there will be a market in the future, when the sál forests recover from past maltreatment, and come into full bearing. These facts indicate the importance of the work at Dehra Dun, which is being organised on lines that must appeal to everyone who has the country's interest at heart.

E. R. B.

[1] "On the Economic Value of *Shorea robusta*, Sál." By R. S. Pearson. Indian Forest Memoirs, Economy Series, vol. ii., part 2. Pp. 70. (Calcutta: Superintendent Government Printing. 1913.) Price 3*s*.

OFFICIAL GUIDES FOR GEOLOGICAL TRAVELLERS.

THE International Geological Congress of 1913 was indeed fortunate in the reception and support accorded to it by the official geological surveys of Canada. The guide-books issued for the excursions were in reality memoirs on the districts traversed, and formed, with their coloured maps and illustrations, works of reference for scientific libraries. They have now been re-issued for the general public, and seven of these handy volumes have reached us from the Department of Mines in Ottawa.

No. 1, in two parts, covers Eastern Quebec and the Maritime Provinces, and is largely of stratigraphical interest. No. 2 deals with the eastern townships of Quebec and eastern Ontario, including the amphibolites and limestones of the Bancroft area. The metamorphic origin of amphibolites from both igneous rocks and limestone, as recognised by Lacroix and others in Europe, is here concisely described. No. 3 is concerned with the neighbourhood of Montreal and Ottawa, including areas of interesting igneous alkali-rocks, and the original locality of the serpentinous marble known as Eozoön. No. 4 describes excursions in south-western Ontario (where the interest for most geological visitors centres in Niagara Falls) and the history of the great lake system. No. 5 deals with Ordovician and Gotlandian beds in the western peninsula of Ontario, and contains a fine illustration of a mass of bedded limestone overthrust by ice-pressure on the flank of a Glacial drumlin. We are informed that Nos. 6 and 7, on the Toronto region and the rich mining districts of Ontario respectively, are issued by the Bureau of Mines, Toronto. The Dominion Department of Mines in Ottawa, however, is also responsible for No. 8, in three parts, and No. 9, which describe the whole transcontinental routes from Toronto to Victoria, and for No. 10 on Northern British Columbia, the Yukon Territory, and the North Pacific Coast. Nos. 8 and 9, on the Canadian Pacific, Grand Trunk, Canadian Northern, and National Transcontinental lines, should meet with especial appreciation.

Such guidance as is here provided for those who may be styled "post-graduate" visitors shows how official surveys may aid in opening up a country Seeing that conference with workers from other fields is highly stimulating to those who must devote themselves to special areas of their homelands, the encouragement given to strangers is sure to bring a full reward. Even in our well-explored islands, descriptions of districts which have become classical in the history of geology might with advantage be issued for those visitors who can devote only a few days to the ground. We are apt to leave some clever teacher or some local enthusiast to extract such matter from our detailed official memoirs, and thus to produce a compact and reasonable guide. The union of our geological surveys, both in Great Britain and in Ireland, with departments concerned with public education suggests that the encouragement of geological travel may well lie within their scope.

PLANT-AUTOGRAPHS AND THEIR REVELATIONS.[1]

In answering the question whether there is a fundamental unity in the response of plant and animal, we have first to find out whether sensitiveness is characteristic of only a few plants or whether all plants and every organ of every plant is sensitive. Then we have to devise apparatus by which visible or invisible reactions are detected and recorded. Having succeeded in this, we have next to survey the characteristic reactions in the animal, and observe whether phenomena corresponding to these may also be discovered in the plant.

Thus, when an animal is struck by a blow, it does not respond at once. A certain short interval elapses between the incidence of the blow and the beginning of the reply. This lost time is known as the latent period. In the plant is there any definite period which elapses between the incident blow and the responsive twitch? Does this latent period undergo any variation as in the animal, with external conditions? Is it possible to make the plant itself write down this excessively minute time-interval?

Next, is the plant excited by various irritants which also excite the animal? If so, at what rate does the excitatory impulse travel in the plant? In what favourable circumstances is this rate of transmission enhanced, and in what other circumstances is it retarded or arrested? Is it possible to make the plant itself record this rate and its variation? Is there any resemblance between the excitatory impulse in the plant and the nervous impulse in the animal?

The characteristic effects of various drugs are well known in the case of the animal. Is the plant similarly susceptible to their action? Will the effect of poison change with the dose? Is it possible to counteract the effect of one by means of another?

In the animal there are certain automatically pulsating tissues like the heart. Are there any such spontaneously beating tissues in the plant? If so, are the pulsations in the animal and the plant affected by external conditions in a similar manner? What is the real meaning of spontaneity?

Growth furnishes us with another example of automatism. The rate of growth in a plant is far below anything we can directly perceive. How, then, is this growth to be magnified so as to be rendered instantly measurable? What are the variations in this infinitesimal growth under external stimulus of light and shock of electric current? What changes are induced by giving or withholding food? What are the conditions which stimulate or retard growth?

And, lastly, when by the blow of death life itself is finally extinguished, will it be possible to detect the critical moment? And does the plant then exert itself to make one overwhelming reply, after which response ceases altogether?

Plant-Script.

The plant is acted upon by storm and sunshine, warmth of summer and frost of winter, drought and rain. What coercion do they exercise upon it? What subtle impress do they leave behind? These internal changes are entirely beyond our visual scrutiny. The possibility of these being revealed to us lies in the detection and record of the actual response of the organism to a questioning shock. By the invention of different types of recorders, I have succeeded in making the plant itself write an answering script to a testing stimulus. Thus the plant attached to the recording apparatus is automatically excited by a stimulus absolutely constant. In answer to this it makes its own responsive records, goes through its period of recovery and embarks on the same cycle over again, without assistance at any point from the observer (Fig. 1).

The Resonant Recorder.

In obtaining the actual record of responsive movements in plants we encounter many serious difficulties. In the case of muscle-contraction, the pull exerted is considerable and the friction offered by the recording surface constitutes no essential difficulty. In the case of plants, however, the pull exerted by the motile organ is relatively feeble, and in the movement of the very small leaflets of *Desmodium gyrans* or the telegraph plant, for instance, a weight so small as four-hundredths of a gram is enough to arrest the pulsation of the leaflets. Even in the leaf of Mimosa the friction offered is enough to introduce serious errors into the amplitude and time-relations of the curve. This error could not be removed as long as the writer remained in continuous contact with the writing surface. I was finally able to overcome the difficulty by making an intermittent, instead of a continuous contact. The possibility of this lay in rendering the writer tremulous, this being accomplished by an invention depending on the phenomenon of resonance.

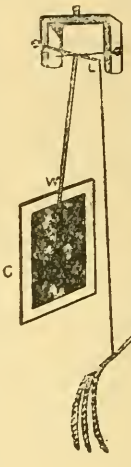
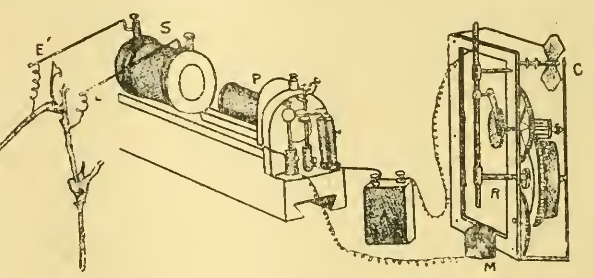

Fig. 1.—Diagrammatic representation of automatic plant-recorder. Petiole of Mimosa, attached by thread to one arm of lever L; writing index W traces on smoked glass plate G the responsive fall and recovery of leaf. P, primary, and S, secondary, of induction coil. Exciting induction shock passes through the plant by electrodes E, E'. A, accumulator. C, clockwork for regulating duration of tetanizing shock. Primary circuit of coil completed by plunging rod R dipping into cup of mercury M.

The principle of my resonant recorder depends on sympathetic vibration If the strings of two violins are exactly tuned, then a note sounded on one will cause the other to vibrate in sympathy. We may likewise tune the vibrating writer V, with a reed C (Fig. 2). Suppose the reed and the writer are both tuned to vibrate a hundred times per second. When the reed is sounded the writer will also begin to vibrate in sympathy. In consequence of this the writer will no longer remain in continuous contact with the recording plate, but will deliver a succession of taps a hundred times in a second. The record will therefore consist of series of dots, the distance between one dot and the next representing one-hundredth part of a second. With other recorders it is possible to measure still shorter intervals. It will now be understood how, by the device of the resonant recorder, we not only get rid of the error due to friction, but make the record itself measure time as short as may be desired. The extraordinary delicacy of this instrument will be understood when by its means it is possible to record a time-interval as short as the thousandth part of the duration of a single beat of the heart. In find-

[1] From a Friday Evening Discourse delivered at the Royal Institution on May 29, by Prof. J. C. Bose.

ing the best mode of applying quantitative stimulus to the plant an interesting discovery was made about the extreme sensitiveness of certain plants to the stimulus of electric current. The most sensitive organ by which an electric current can be detected is our

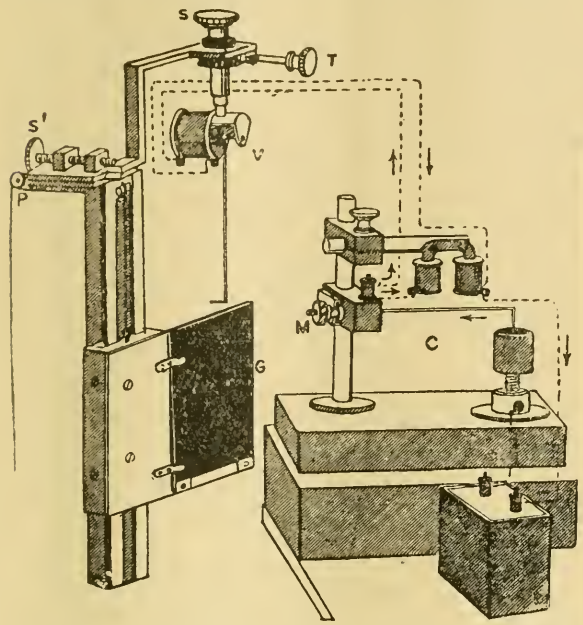

FIG. 2.—Upper part of resonant recorder (from a photograph). Thread from clock (not shown) passes over pulley P, letting down recording plate. S', screw for adjustment of distance of writing-point from recording plate. S, screw for vertical adjustment. T, tangent screw for exact adjustment of plane of movement of recorder, parallel to writing-surface. V, Axis of writer supported perpendicularly at centre of circular end of magnet. C, coercer. M, micrometer screw for adjustment of length of coercer.

tongue. An average European, according to Laserstein, can perceive by his tongue a current as feeble as 6·4 microamperes—a microampere being one-millionth part of the unit of current. This value might be subject to certain variation, depending on racial characteristics. One might expect that the tongue of the Celt would be far more excitable than

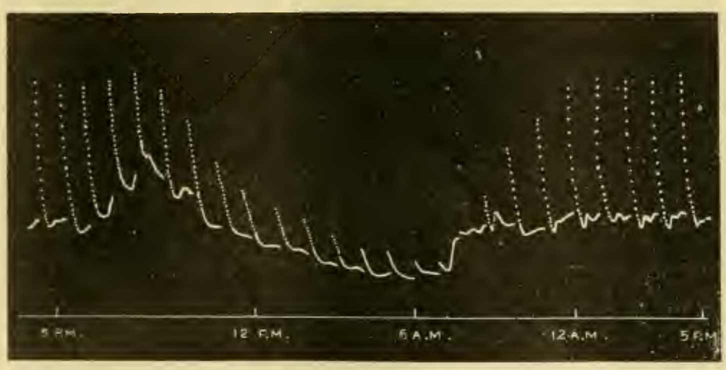

FIG. 3.—Hourly record for twenty-four hours, exhibiting diurnal variation of excitability (spring specimen).

that of the stolid Anglo-Saxon. In any case, the superiority of man has to be established on foundations more secure than sensibility; for the plant Biophytum, I find, is eight times more sensitive to an electrical current than a human being. With regard to the stimulus of induction shock, Mimosa is ten times as sensitive.

The Sleep of Plants.

In studying the effect of a given change in the external condition, an assumption has to be made that during the time of experiment there has been no spontaneous variation of excitability. Is the plant equally excitable throughout day and night? If not, is there any particular period at which the excitability remains uniform? Is there again a different time during which the plant loses its sensibility—going, as it were, to sleep? On these points no definite information has been available. The fanciful name of

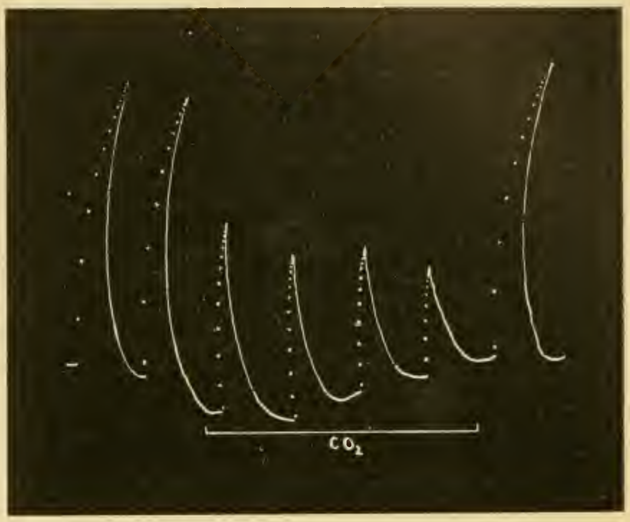

FIG. 4.—Effect of carbonic acid gas.

sleep is often given to the closure of leaflets of certain plants during darkness. These movements are brought about by variation of turgor, and have nothing whatever to do with true sleep; for similar closure of leaflets takes place under the precisely opposite condition of strong light.

In order to find out whether Mimosa exhibits diurnal variations of sensibility, I made it record its answer to uniform questioning shocks, repeated every hour of the day or night. The amplitude of the answering twitch gave a measure of the "wakefulness" of the plant during twenty-four hours. The results obtained were quite unexpected. The plant is found to keep up very late, and fall asleep only at the early hours of the morning. It makes up for its late hours by gradually waking up by noon (Fig. 3). It then remains in a condition of uniform sensibility all the afternoon. This period of uniformity is chosen for investigations on the effect of changed external conditions on excitability.

Effect of Air, Food, and Drugs.

The plant is intensely susceptible to the impurities present in the air. The vitiated air of the town has a very depressing effect. According to popular science, what is death to the animal is supposed to be life for the plant; for does it not flourish in the deadly atmosphere of carbonic acid gas? The record (Fig. 4) shows that, instead of flourishing, the plant gets suffocated just like a human being. Note the gasp of relief when fresh air is introduced. Only in the presence of sunlight is this effect modified by photosynthesis. In contrast to the effect of carbonic acid, ozone renders the plant highly excitable. Sulphuretted hydrogen, even in small quantities, is fatal to the plant. Chloroform acts as a strong narcotic, inducing a rapid abolition of excitability. The ludicrously unsteady gait of the response of plant under alcohol could be effectively exploited in a temperance lecture! The record (Fig. 5) is in the nature of an anticlimax, where the plant has drunk (pure water!) not wisely but too well. The gorged plant is seen to have lost all power of movement. I was, however, able to restore the plant to normal condition by extracting the excess of liquid by application of glycerin.

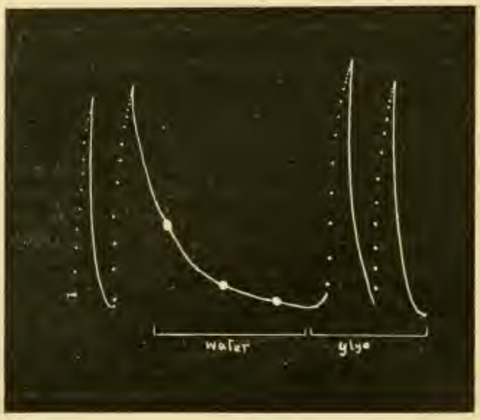

FIG. 5.—Abolition of motile excitability by excessive absorption of water, and subsequent restoration by withdrawal of excess.

It may be urged that the various reactions of irritability may hold good only in the case of the particular plant Mimosa, and that the majority of plants were quite insensitive. I have, however, been able to demonstrate in this very hall thirteen years ago, through my discovery of electric response in ordinary plants, that every plant and every organ of the plant is sensitive.[2] The difficult problem of finding the time taken by the plant to perceive and respond to a blow was solved by the employment of my resonant recorder, in which the writer was tuned to vibrate two hundred times a second. The successive dots are thus at intervals of 1/200 part of a second apart. In a particular experiment there are 15·2 intervals between the application of stimulus, represented by a vertical line, and the initiation of response (Fig. 6). The latent period, therefore, in this case is 0·076 of a second. The reaction time of the plant becomes very sluggish under fatigue.

Excitatory Impulse in Mimosa.

I next take up the question of transmission of excitation in plants. It has hitherto been supposed in Mimosa the impulse caused by irritation is merely hydro-mechanical, and quite different from the nervous impulse in the animal. According to this hydro-mechanical theory, the application of mechanical stimulus is supposed to squeeze the tissue, in consequence of which the water forced out delivers a mechanical blow to the contractile organ of the plant. Such hydromechanical transmission is in no way affected by any physiological agencies as warmth or cold, or the application of various anæsthetics or poisons.

In strong contrast to this is the transmission of nervous impulse, which is a phenomenon of passage of protoplasmic disturbance from point to point. Here under favourable physiological conditions, such as warmth, excitatory impulse is transmitted with a quicker speed. There are certain agents again which paralyse the conducting tissue for the time being, causing a temporary arrest of the impulse. Such agents are known as anæsthetics. There may again be poisonous drugs which permanently abolish the conducting power. The nature of an impulse may thus be discriminated by several crucial tests. *The impulse must be physiological, or of a nervous character, if physiological changes affect the rate of conduction; absence of such effect, on the other hand, proves the mechanical character of the impulse.*

Of the various physiological tests, Pfeffer employed that of the narcotic drug. Chloroform applied on the *surface* of the stem of Mimosa failed to arrest the impulse. This result, at first sight, appears most convincing, and has been universally accepted as a disproof of the existence of nervous impulse in Mimosa. A little reflection will, however, show that under the particular conditions of the experiment, the conducting tissue in the interior could not have been affected by the external application of the narcotic, the task being, in fact, as difficult as narcotising a nerve-trunk lying between muscles by the application of chloroform on the skin outside.

The question of nervous impulse in plants has thus to be attacked anew, and I have employed for this purpose twelve different methods. They all prove conclusively that the impulse in the plant is identical in character with that in the animal. Of these I shall give a short account of two different modes of investigation. It is obvious that the transmitted impulse in Mimosa must be of an excitatory, or nervous character :—

(1) If it can be shown that physiological changes induce appropriate variation in the velocity of transmission of the impulse.

(2) If the impulse in the plant can be arrested by different physiological blocks by which nervous impulse in the animal is arrested.

For the last two investigations the research resolves itself into the accurate measurement of the speed with which an impulse in the plant is transmitted, and the variation of that speed under changed conditions. A portion of the tissue at C may, for example, be subjected to the action of cold, or of a poisonous drug (Fig. 7). In order to find the speed of normal transmission, we apply an instantaneous stimulus, say, of an electric shock, at B, near the pulvinus. A short interval, the latent period, will elapse between the application of stimulus and the beginning of responsive movement. After the determination of the latent period, we apply stimulus once more at A, and observe the time which elapses between the application of

FIG. 6.—Record showing the latent period of Mimosa. The recorder vibrates 200 times per second. The time-interval between successive dots is here 0·005 sec.

[2] Bose: Friday evening discourse, May 10, 1901.

stimulus and the response. The difference between the two periods gives us the time required for the excitation to travel from the point of application of stimulus at A, to the responding organ at B; hence we obtain the speed of impulse in the plant. The experiment is repeated once more, after the application of a given agent at C. If the speed undergoes any variation, it must be due to the action of the given agent.

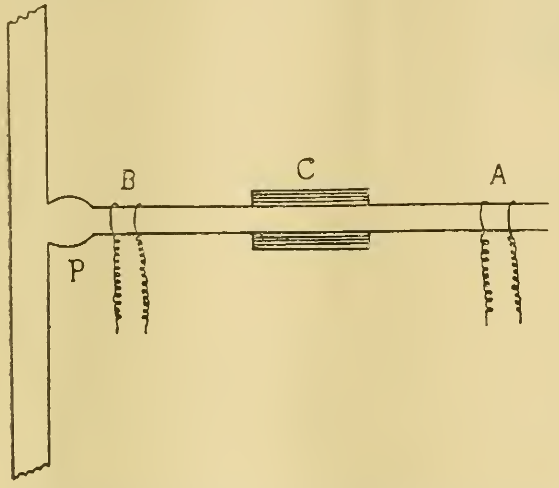

FIG. 7.—Experimental arrangement for determination of velocity of transmission and its variation. Record is first taken when stimulus is applied near the pulvinus at B (latent period) and then at a distant point on the leaf-stalk at A. Difference of two gives time for transmission from A to B. The band of cloth C is for local application of warmth, cold, anæsthetics, and poison.

Determination of Speed of Excitatory Impulse in Plants.[3]

As relatively long intervals have to be measured in the determination of velocity, the recorder has its frequency adjusted to ten vibrations per second; hence the space between successive dots represents an interval of one-tenth of a second. In Fig. 8 is given a record for determining the velocity of transmission.

FIG. 8.—Determination of velocity of transmission in Mimosa. The two lower records are in response to stimulus applied at a distance of 30 mm.; the upper record exhibits latent period in response to direct stimulus applied on the pulvinus. Successive dots in this and following records are of intervals of one-tenth part of a second.

The two lower figures give practically identical results of successive experiments when stimulus was applied at a distance of 30 mm. The uppermost is the record for direct stimulation. From these it is seen that the interval between stimulus and response is 1·6 seconds, and that the latent period is 0·1 second. Hence the true time for the excitation to travel through a distance of 30 mm. is 1·5 seconds, the velocity being 20 mm. per second.

The velocity of nervous impulse in the plant is slower than those of higher, but quicker than those of lower animals. The speed of the impulse is, however, subject to variation under different conditions. One significant result that came out was that while a plant carefully protected under glass from outside blows looked sleek and flourishing, yet as a complete and perfect organism it proved to be a failure. Its conducting power was found atrophied or paralysed. But when a succession of blows rained on this effete and bloated specimen, the stimulus canalised its own path of conduction, and it became more alert and responsive, and its nervous impulses became very much quickened.

Effect on Physiological Agencies on Velocity.

A decisive experiment to discriminate between the theories of mechanical and nervous transmissions, consists in the determination of the effect of temperature on the speed of transmission. Temperature has no effect on mechanical propagation, whereas a moderate variation of it profoundly affects the rate of nervous transmission. In the case of the plant, I find that the velocity is doubled by rise of temperature through 9° C. When a portion of conducting petiole is subjected to cold the speed of conduction is retarded. Excessive cold temporarily abolishes the conducting power.

As an after-effect of the application of intense cold, the conducting power remains paralysed for a considerable length of time. It is a very interesting and suggestive fact that I have been able to restore the conducting power quickly by subjecting the paralysed portion of the plant to a measured and moderate dose of electric shock.

Various physiological blocks can be made to inhibit the excitatory impulse in the plant, precisely as in the case of animal nerve. The nervous impulse in plants may thus be arrested by electrotonic block or by the action of poisons. By applying solution of potassium cyanide I have been able to abolish the conducting power in the plant in a time as short as five minutes. This investigation on the simplest type of plant-nerve is expected to cast a flood of light on the very obscure phenomenon of nervous impulse in general, and the causes operative in bringing about the degeneration of the normal function of the nerve.

Spontaneous Pulsation.

In certain animal tissues, a very curious phenomenon is observed. In man and other animals, there are tissues which beat, as we say, spontaneously. So long as life lasts, so long does the heart continue to pulsate. There is no effect without a cause. How then was it that these pulsations became spontaneous? To this query, no fully satisfactory answer has been forthcoming. We find, however, that similar spontaneous movements are also observable in plant tissues, as in *D. gyrans*, or the telegraph plant, the leaflets of which dance up and down. The characteristics of the automatic pulsations in the plant could not be determined on account of the apparent impossibility of obtaining a record. The leaflets are too minute and the pull exerted too feeble to overcome friction of the recording surface. This difficulty has been obviated by the device of my oscillating recorder (see pulse-record, Fig. 9). From the records thus obtained, I am enabled to say that the automatic movements of both plants and animals are guided by laws which are identical. Thus I find, as

[3] For a more detailed account consult:—
Bose: "An Automatic Method for the Investigation of Velocity of Transmission of Excitation in Mimosa." Phil. Trans. Royal Society, Series B, vol. cciv.
Bose: "Plant Response." (Longmans, Green, 1906).
Bose: "Researches on Irritability of Plants." (Longmans, Green, 1913.)

with the pulsating heart, so also with the pulsating leaflet, the rhythmic frequency is increased under the action of warmth, and lessened under cold, increased frequency being attended by diminution of amplitude, and *vice versâ*. Under ether, there is a temporary arrest, revival being possible when the vapour is blown off (Fig. 10). More fatal is the effect of chloroform. The most extraordinary parallelism, however, lies in the fact that those poisons which arrest the beat of the heart in a particular way, arrest the plant-pulsation also in a corresponding manner, the arrest produced being either at systole or diastole, depending on the characteristic reaction of the poison. Taking advantage of the antagonistic reactions of specific poisons, I have been able to revive a poisoned leaflet by the application of another counteracting poison

FIG. 9.—Record of automatic pulsations in *Desmodium gyrans*.

FIG. 10.—Arrest of pulsation of Desmodium under ether; restoration of pulsation on blowing off ether. The arrow indicates the time of application.

Instantaneous Record of Growth.

As a further example of automatic activity we may take the phenomenon of growth. The rate of growth is so extremely slow that even the proverbial pace of the snail is two thousand times quicker! It would take an average plant two hundred years to cover the short distance of a mile. This extreme slowness is a serious drawback in the investigation on growth. For even with the existing magnifying growth-recorders it would take many hours for the variation of growth to be recorded under a changed condition in the environment. The results thus obtained are subject to errors brought about by the variation of growth which takes place spontaneously in the course of a few hours. Growth can be assumed to remain constant only for a short time; on this account it is necessary to conclude an experiment in the course of a few minutes.

The difficulties have been overcome in my high magnification crescograph, which records the absolute rate of growth in a time so short as the single beat of the pendulum. The various magnifications available are a thousand or ten thousand times. For demonstration purposes I have been able to secure a magnification of a million times. The infinitesimal growth thus becomes magnified so as to appear rushing forward as if in a race. The actual rate of growth and its variations under the action of drugs, of food-materials, of various electrical and other forms of stimuli, are thus recorded in the course of a few minutes. The great importance of this method of investigation in agriculture is sufficiently obvious.

The Plant's Response to the Shock of Death.

A time comes when, after an answer to a supreme shock, there is a sudden end of the plant's power to give any further response. This supreme shock is the shock of death. Even in this crisis there is no immediate change in the placid appearance of the plant. Drooping and withering are events that occur long after death itself. How does the plant, then, give this last answer? In man, at the critical moment, a spasm passes through the whole body, and similarly in the plant I find that a great contractile spasm takes place. This is accompanied by an electrical spasm also. In the script of the death-recorder the line, that up to this point was being drawn, becomes suddenly reversed and then ends. This is the last answer of the plant.

The plant has thus been made to exhibit many of the activities which we have been accustomed to associate only with animal life. In one case, as in the other, stimulus of any kind will induce a responsive thrill. There are rhythmic tissues in the plant which, like those in the animal, go on throbbing ceaselessly. These spontaneous pulsations in one case, as in the other, are affected by various drugs in an identical manner. And in one case, as in the other, the tremor of excitation is transmitted with a definite and measured speed from point to point along conducting channels. The establishment of this similarity of responsive actions in the plant and animal will be found of the highest significance; for we now realise that it is by the study of the simpler phenomena of irritability in the vegetal organisms that we may expect to elucidate the more complex physiological reactions of the animal.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The recent endowment of the Poynting chair of physics by Sir George Kenrick fulfils the purpose of perpetuating the memory of the late Prof. Poynting; but it is known that a number of friends and admirers would welcome the opportunity of contributing to a memorial of a somewhat more personal kind. A circular is, therefore, being issued by a representative committee, inviting contributions to a Poynting Memorial Fund. The proposed objects of this fund are (*a*) the execution of a portrait of the late professor, either as a painting or as a medallion; (*b*) the publication of his collected scientific papers; and (*c*) the formation of a fund from which assistance can be given to research students in physics. Donations and promises to the amount of about 350*l*. have been received already, but it is hoped that at least 1000*l*. will be realised. The hon. secretary is Mr. G. H. Morley, and the hon. treasurer Dr. G. A. Shakespear, to whom contributions may be sent.

LONDON.—At the meeting of the Senate on July 15, the last of the present session, the D.Sc. degree was conferred on the following students:—Mr. David Segaller, of the South-Western Polytechnic, in chemistry; Mr. J. H. Orton, of the Royal College of Science, in zoology; and Mr. H. Chatley and Mr. G. S. Coleman, external students, in engineering.

Mr. T. S. Moore was appointed to the University chair of chemistry tenable at Royal Holloway College. Since 1907 Mr. Moore has been tutor in chemistry at Magdalen College, Oxford.

In response to a request from the Board of Control for suggestions as to methods of encouraging scientific research into the causes and treatment of mental diseases and mental defect, it was decided to recommend that individual grants should be given to a few thoroughly trained observers for the investigation of fundamental problems.

A FURTHER gift of 10,000*l*. has been made to the Medical School of University College, Cardiff, by the anonymous donor who has already undertaken the erection of the Medical School Buildings. The gift is conditional on certain contributions by the Treasury to the upkeep.

Mr. H. S. Rowell has been appointed to the position of senior lecturer in mechanical engineering at Bradford Technical College, and will commence his duties in September next.

Mr. Frederick Soddy, lecturer in physical chemistry in the University of Glasgow, has been appointed to the chair of chemistry at the University of Aberdeen, in succession to Prof. F. R. Japp.

Prof. J. S. Macdonald, professor of physiology in the University of Sheffield since 1903, has been appointed Holt professor of physiology in the University of Liverpool, in succession to Prof. C. S. Sherrington.

Dr. T. J. Jehu, lecturer on geology at the University of St. Andrews, has been appointed Murchison regius professor of geology and mineralogy in the University of Edinburgh, in succession to Prof. James Geikie, who lately resigned the chair.

The Extension Lecture scheme of the Selborne Society has become so successful that it has been found possible this year to issue a handbook of fifty pages giving particulars of nearly two hundred lectures. The addresses are mainly of a popular character, and are by lecturers who command high fees as well as by those who will accept a small honorarium, or in exceptional cases merely their travelling expenses. The society hopes that in this way it may be of considerable assistance to societies and schools, whether large or small, by enabling them to secure the services of competent lecturers. There are many local societies which cannot afford big fees, and plenty of county people who are glad to arrange lectures in their villages, and to these the handbook should prove most useful. The Selborne Society during the coming winter will arrange courses of these lectures in London and the provinces. Particulars can be obtained from the Extension Lecture Secretary, Mr. Percival J. Ashton, 37 Walbrook, London, E.C.

An appeal on behalf of the Equipment and Endowment Fund Committee of University College, Gower Street, W.C., has been issued by the Hon. Rupert Guinness, M.P., who is the chairman of the executive committee. The committee has been engaged for some years in endeavouring to collect funds to meet the capital expenditure which has become necessary for the proper development of several departments of the college work. These efforts have already met with much success. The London County Council has made a grant of 30,000*l.*, and this grant has encouraged the committee to renew the endeavour to obtain the money required to complete work already in hand and necessary to enable the college to discharge with proper efficiency its present functions. The sum immediately required is about another 30,000*l.* The money is wanted for four main purposes:—(i) About 10,000*l.* to complete the equipment of the new chemical laboratories, especially that for physical chemistry. (ii) A large hall to serve as an examination room, for ceremonial assemblies and for public lectures. For this, about 12,000*l.* is required. (iii) A benefactor has erected, at a cost of 35,000*l.*, buildings to accommodate the University School of Architecture and the Department of Applied Statistics and Eugenics. To complete this part of the college about 6000*l.* is required. (iv) The college libraries contain about 130,000 books and more than 17,000 pamphlets, but the proper custody and arrangement of the books and manuscripts, as well as the use of them by readers, are interfered with by want of space. To remedy these disadvantages will cost 2500*l.* The current work of the college is hampered badly, and much-needed developments are arrested, until these four objects are provided for fully. The Equipment and Endowment Fund Committee, of which Prince Arthur of Connaught is president, consequently feels that, in urging the claims of University College on the favourable consideration of all who recognise the importance of providing facilities for advanced study and investigation, it is doing work of national value. We trust the efforts of the committee in their public-spirited work on behalf of higher education in London will soon be rewarded, and that the funds needed so urgently will be speedily forthcoming. Contributions may be sent to the president or to the chairman of the executive committee, at University College, Gower Street, London, W.C.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, July 13.—M. P. Appell in the chair.—Paul **Sabatier** and Léo **Espil**: The reduction of the oxides of copper, lead, and nickel. Using calcium carbide as an indicator of the production of water, the reduction of cupric oxide in dry hydrogen is clear at 120° C. For lead dioxide, the corresponding temperature is 150° C. Nickel oxide, NiO, on reduction at low temperatures gives a mixture of metallic nickel and a suboxide of doubtful composition.—A. **Haller** and Mme. **Ramart-Lucas**: Syntheses by means of sodium amide. The oxide of propylenedimethylacetophenone and some of its derivatives. A new method of preparation of the γ-ketonic acids.—Charles **Moureu** and Georges **Mignonac**: Additional examples of the class of compounds described in a recent paper, and containing the grouping $RR'C=N-CRR''$. On hydrolysis, ammonia and a ketone are the products.—M. **Calmette** and L. **Massol**: The preservation of cobra poison and its antitoxin. Cobra poison slowly loses its toxic power on keeping; the antitoxin is absorbed not only by the toxic substance of the snake poison, but also by other substances accompanying it. The antitoxin serum preserves its power for at least six years.—Ph. A. **Guye** and F. E. E. **Germann**: The analysis of very small quantities of gas; application to the analysis of air. The apparatus illustrated is based on the application of a modified MacLeod gauge. An example of an analysis of air with the apparatus is given, in which the initial volume was only 0·25 c.c.—Maurice **Paschoud**: Application of the method of Walther Ritz to the problem of the uniform *régime* in a tube with square section.—J. **Boussinesq**: Observations on the preceding note of M. Paschoud.—Farid **Boulad bey**: A new theorem on elastic displacements and its application to the simplification of the direct calculation of reactions of the supports of continuous beams.—E. **Estanave**: The exteriorisation of the photographic image by the autostereoscopic plate.—P. Le **Rolland**: The determination of the ratio of the times of oscillation of two pendulums. A modification of the photographic method described by Lippmann in 1897. For a period of comparison of only three minutes the ratio of the times can be determined with an accuracy of one part in a million. The photographic method possesses several advantages over the method of coincidences, especially if the difference between the times of oscillation of the two pendulums is small.—C. G. **Bedreag**: Electrification by the X-rays. The square of the maximum velocity of the electrons emitted is proportional to the frequency of the incident X-radiation.—G. **Millochau**: A new pyrometric method based on the absorption of some substances for the integral radiation. The determination of a temperature with the Féry pyrometer is extended to cases in which the image of the opening in the hot body is smaller than the blackened disc fixed to the thermo-electric couple. Readings are taken of the deviations with and without the interposition of absorptive plates of mica, glass, or celluloid.—MM. **Massol** and **Faucon**: The ultra-violet spectra of aqueous solutions of nitric acid, metallic nitrates, and particularly of copper nitrate.—P. **Chevenard**: The expansion of ferro-nickels over a large range of temperature. Measurements were made of the expansion between $-195°$ C. and $750°$ C., for a series of alloys containing increasing proportions of nickel. The results are given in the form of diagrams.—B. **Bogitch**: The ternary alloy of zinc, silver, and lead.—F. **Taboury**: Glucinum sulphate and its hydrates.—J. **Clarens**: The chlorometric method of Penot.—Marcel **Guichard**: A new method of determination of the atomic weight of iodine. The method is based on the use of purified iodine pentoxide, and its decomposition into iodine and oxygen by a high temperature. These elements are weighed separately. The general mean of the experiments was, for $O=16$, $I=126.92$, identical with the value currently accepted.—L. **Tschugaeff**: A new method of preparation of the complex compounds of bivalent platinum.—André **Brochet** and Maurice **Bauer**: The addition of hydrogen to aliphatic compounds with ethylene linkages in presence of nickel under moderate pressure. The reactions were carried out at the ordinary temperature under hydrogen pressures of fifteen atmospheres or less. Descriptions of the reduction of *l*-octene, cinnamic acid, sodium cinnamate, methyl cinnamate, piperonylacrylic acid, eugenol, sapol, and isoeugenol are given.—Maurice **Lugeon**: The autochone strata below the Morcles layer.—Emile **Haug**: New observations on the tectonic of the valley of Saint Pons, near Gémenos (Bouches-du-Rhône).—P. **Idrac**: The irregularities of the wind. —Julien **Loisel**: The nomographic representation of the reduction of the barometer to sea-level.—O. **Lignier**: New contributions to the knowledge of the flower of the Fumarieæ and the Cruciferеæ.—Edgar **Zaepffel**: The distribution of the stomata in the plantules of some graminaceous plants.—E. **Chuard** and R. **Mellet**: Nicotine in the by-products of the culture of tobacco. The waste products of tobacco culture contain sufficient nicotine to be of commercial value in the preparation of insecticides.—J. **Künckel d'Herculais**: Correlation between the mortality of *Ailanthus glandulosa* and the disappearance of *Samia cynthia*.—Em. **Bourquelot** and Al. **Ludwig**: The biochemical synthesis of the β-monoglucosides of meta- and para-xylene glycols.

BOOKS RECEIVED.

Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere. Band i. Die Wasserstoffionen-Konzentration. By Prof. Dr. L. Michaelis. Pp. xiv+210. (Berlin: J. Springer.) 8 marks.

Journal of Genetics. Vol. iv. No. 1. June. Pp. 107. (Cambridge University Press.) 10*s.* net.

The Biochemical Journal. Vol. viii. No. 3. June. Pp. 217–280. (Cambridge University Press.) 7*s.* net.

Grundzüge der Mengenlehre. By Prof. F. Hansdorff. Pp. viii+476. (Leipzig: Veit and Co.) 18 marks.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. iii. Artiodactyla, Families Bovidæ, Subfamilies Æpycerotinæ to Tragelaphinæ (Pala, Saiga, Gazelles, Onyx Group, Bushbucks, Kudus, Elands, etc.) Antilocapridæ (Prongbuck) and Giraffidæ (Giraffes and Okapi). By R. Lydekker. Pp. xv+283. (London: British Museum (Natural History), and Longmans, Green and Co.) 7*s.* 6*d.*

Quarterly Journal of the Royal Meteorological Society. Vol. xl. No. 171. July. Pp. 185–256. (London: E. Stanford, Ltd.) 5*s.*

Botanische Jahrbucher für Systematik Pflanzengeschichte und Pflanzengeographie. Edited by A. Engler. Band li. 3 u. 4 Heft. Pp. 225–512. (Leipzig and Berlin: W. Engelmann.) 18 marks.

Gegenbaurs Morphologisches Jahrbuch. Edited by Prof. G. Ruge. Band xlix. Heft 1. Pp. 178. (Leipzig and Berlin: W. Engelmann.) 13 marks.

Zeitschrift für wissenschaftliche Zoologie. Edited by Prof. E. Ehlers. Band cix. Heft 3. Pp. 349–530. 13 marks. Band cix. Heft 4. Pp. 531–696. 11 marks. Band cx. Heft 1. Pp. 149. 15 marks. Band cx. Heft 2. Pp. 150–301. 10 marks. (Leipzig and Berlin: W. Engelmann.)

Woburn Experimental Fruit Farm. Fourteenth Report of the Woburn Experimental Fruit Farm. Pp. 151. (London: Amalgamated Press.) 2*s.* 9*d.*

Department of Commerce. U.S. Coast and Geodetic Survey. Hypsometry. Fourth General Adjustment of the Precise Level Net in the United States and the Resulting Standard Elevations. Special Publication No. 18. By E. Bowie and H. G. Avers. Pp. 328. (Washington: Government Printing Office.)

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THURSDAY, JULY 30, 1914.

MAMMALIAN EVOLUTION.

A History of Land Mammals in the Western Hemisphere. By Prof. W. B. Scott. Pp. xiv+693. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 21s. net.

THIS important work is, perhaps, the most successful attempt that has yet been made to bring within the reach of the lay reader a general account of the past history of the mammalia, a history for the reconstruction of which a vast amount of material is now available. It may be regretted that the author has found it necessary to confine his work to the mammals of the Western Hemisphere, but since the successive faunas inhabiting that region, particularly the northern half, are far better known than those of the Old World, none of the main lines along which evolution has proceeded within the group is left without adequate illustration. The much greater degree of completeness of our knowledge of the mammals of the New World is not merely due to the occurrence there of a more nearly continuous series of mammal-bearing tertiary deposits, but also to the systematic collecting that has been carried out, both in the north and south, by expeditions organised by the museums and universities. Prof. Scott has himself led such expeditions on several occasions.

The plan of the work is excellent, especially from the point of view of the general reader. The earlier chapters give a simple summary of the methods of investigation, both from a geological and palæontological point of view. A valuable chapter is added giving a brief, but clear, account of the mammalian skeleton and dentition; this with the accompanying figures should render the descriptions given in the later part of the work easily understood. A chapter on the living mammals of America is followed by a history of the succession of mammalian faunas back to the earliest Eocene, the pre-Tertiary forms being omitted. So far the volume may be regarded as an introduction to mammalian palæontology generally. In the succeeding part of the work the evolution of each group is traced in detail from its earliest appearance onwards, and it is this section which will be a revelation to those who are unacquainted with the enormous amount of material for the history of the phylum that has accumulated during the last quarter of a century. All zoologists who, from various points of view, are dealing with the question of the manner in which evolution has taken place, should read this summary of results, in which much light is thrown on such points as the occurrence of parallel and convergent evolution and on the origin of polyphyletic groups.

It is often forgotten that in palæontology we are dealing with what actually has happened, and nowhere is this better known than in the case of the mammalia. Prof. Scott himself seems to be somewhat unduly pessimistic as to the present state of palæontology, comparing it with the condition of philology in the time of Voltaire, whose famous remark: "L'étymologie est une science ou les voyelles ne font rien et les consonnes fort peu de chose," he quotes. The fact that it has been possible to write this book seems to be sufficient proof that matters are not so bad as he appears to believe.

A large number of excellent illustrations are given, many being restorations of extinct mammals, a considerable number now appearing for the first time. A useful glossary and a very complete index are appended. C. W. A.

THE PRODUCTION AND UTILISATION OF CROPS.

(1) *The Manuring of Market Garden Crops.* By Dr. Bernard Dyer and F. W. E. Shrivell. New Edition. Revised and brought up to date. Pp. 149. (London: Vinton and Co., Ltd. 1913.) Price 1s.

(2) *The Chemistry of Cattle Feeding and Dairying.* By J. Alan Murray. Pp. xii+343. (London: Longmans, Green and Co., 1914.) Price 6s. net.

(3) *Garden Farming.* By L. C. Corbett. Pp. x+473. (Boston and London: Ginn and Co., n.d.) Price 8s. 6d.

(1) THE first book on our list, by Dr. Dyer and Mr. Shrivell, is now well-known to all who are concerned in the raising of market garden crops. It gives the results of a series of trials at Golden Green, Hadlow, Tonbridge, which were begun in 1894 and have been systematically carried out since, so that they are now in their twentieth year.

When the experiments began little was known as to the effect of the various artificial manures on market garden crops. Many trials had been made with ordinary farm crops, but not much had been done with fruit and practically nothing with ordinary vegetables. The market gardener still used large quantities of stable manure and looked with more or less suspicion on all the purchased

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artificials which were offered to him. However, the supply of stable manure tends to decrease, and twenty years have seen very considerable displacement of horse traffic by motor traffic and electric tramways so that, instead of being able to bring out large quantities of stable manure from the cities at a very low price or even for nothing, the market gardener has been compelled to buy at prices which show an uncomfortable tendency to rise. Indeed, the authors go so far as to predict that at no distant time town stable manure will be for many of its long-accustomed users an unattainable luxury.

The authors, therefore, laid out a series of experiments to see what would be the effect of artificial manures on market garden crops, and whether the same sort of results would be obtained as on ordinary agricultural crops. The results were as might have been expected; the artificials exerted their full effect and gave crops as large as those obtained in the ordinary way, sometimes even larger. A certain foundation of organic manure is necessary in order to give satisfactory tilth to the soil and to increase its water-holding capacity. But this does not necessitate the large quantities which had formerly been used, and the authors make some useful suggestions as to the way in which stable manure may be supplemented by artificials so that considerably increased crops may be obtained.

(2) Mr. Alan Murray is well known as a careful and painstaking teacher who takes a good deal of trouble over the preparation of his lectures and of his books.

In the volume before us he gives a very interesting account of the chemistry of cattle feeding and dairying drawn up for the students at agricultural colleges and elsewhere. It is divided into four parts. The first deals with the chemistry of plants and animal constituents and includes chapters on the carbohydrates, the fats, proteins, etc.; the second deals with the physiology of nutrition and milk production; the third with the properties of feeding stuffs, and the fourth with dairying. It is obviously a good deal to expect of one man that he should cover so wide a range of subjects, and we hope the time is not far distant when teachers of agricultural chemistry will not be under the necessity of giving preliminary courses of advanced organic chemistry and elementary physiology.

We think, perhaps, Mr. Murray would have done wisely to have made more use of the series of bio-chemical monographs edited by Plimmer and Hopkins, instead of the less recent books that he quotes. Probably some such method would be a simple way out of the difficulty at the colleges at present; undoubtedly the students do need these preliminary courses in organic chemistry and physiology, but it is unreasonable that the agricultural chemist should be required to give them.

Passing on to the more strictly technical side, the descriptions of the feeding stuffs and methods of compounding rations are very well done, and a graphic method is given for working out some of the practical problems which will greatly facilitate the work of teacher and student. There is also an interesting chart showing the composition of the foods. Altogether the book is one that cannot fail to be useful.

(3) This book is frankly technical and written for the American grower. It, therefore, naturally appeals much less to the English reader than to those in the States. The general reader, however, will find an interesting account of the cultivation of certain crops. Beans play a large part in American dietaries, and large areas are given up to their cultivation in certain sections of the States, particularly in New York and Michigan. Indeed, in some parts beans have become as much a staple crop as wheat was a quarter of a century ago, and have largely displaced it.

The growth of sweet corn is also dealt with at length, the methods of cultivation, of harvesting, and the varieties being fully described. At present 80 per cent. of the seed corn is grown in Nebraska, but large amounts are raised in the other States for the canning industry, the requirements of which are enormous.

The ordinary potato is described as the Irish potato in contradistinction to a wholly different crop, the sweet potato (*Ipomoea batatas*); it received this name from the fact that it is one of the standard foods of the Irish people. "Because of its enormous yields," the author states, "and its easy cultivation, it has grown to be an important economic factor in the maintenance of the dense population of that country." Potatoes as a farm crop bulk largely in the north-eastern section of the States, where the method of growth is not unlike ours and the same sort of troubles seem to arise. There is one pest, however, from which we have fortunately been free: the Colorado potato beetle, described as being the most serious insect enemy of the potato.

Each crop is carefully described, and there are maps showing their distribution in the States. Altogether, it is a book that the American grower is not likely to be able to dispense with, and so far as one can judge, the information seems to be very sound; it is certainly well put together and illustrated with plenty of good photographs.

E. J. R.

ROBERTS-AUSTEN.

Roberts-Austen: a Record of his Work. Being a Selection of the Addresses and Metallurgical Papers, together with an Account of the Researches of Sir William Chandler Roberts-Austen. Compiled and edited by S. W. Smith. Pp. xii+382. (London: C. Griffin and Co., Ltd., 1914.) Price 21*s.* net.

It is pleasant to see that one of Roberts-Austen's former assistants has been willing to devote himself to the preparation of this record of the work of the most distinguished metallurgical chemist of his day. It is pleasant, too, to find that the handsome volume which is the result of Mr. Smith's labour of love is a memorial in every way worthy of his old professor's fame. In well-chosen, felicitous language, Mr. Smith traces Sir William's career from his student days at the Royal School of Mines to his death at the age of fifty-nine, when he was still actively engaged in many directions. For the most part, however, the biographer leaves him to speak for himself.

A large part of the book is taken up with a reprint of lectures and addresses delivered to his students, to the British Association, to the Society of Arts at the Royal Institution, and as president of the Iron and Steel Institute. These addresses are the best expression of Roberts-Austen's personality. They reveal how very much "worth while" he found metallurgy to be. They show the enthusiasm with which he sought to open out ways for the escape of what he felt to be "imprisoned splendour." The papers giving the results of Roberts-Austen's own experimental researches have been usefully summarised by Mr. Smith, who has made their spirit live without encumbering his pages with details. No work has been entirely omitted. The record is complete.

Roberts-Austen's life was largely given to the Mint. As the assayer for more than thirty years, he was responsible for the accuracy of the composition of more than 150,000,000*l.* of gold and 31,000,000*l.* of silver coins. In his hands the scientific reputation of the Mint was maintained at a high level. He was also for many of these years the professor of metallurgy at the Royal School of Mines. His numerous researches on the properties of metals and alloys were so important as to obtain immediate recognition from the scientific world. His work on government committees was almost unceasing. If, however, an opinion may be expressed by one of his admirers, it is that he will be best remembered for the impetus which he gave to the scientific study of metals at a time when it was beginning to be understood that empiricism must give place to system even in metallurgy. If the metallurgical industries are paying more and more attention to the need of applying scientific principles in their practice, the movement is largely due to Roberts-Austen's initiative and enthusiasm.

T. K. Rose.

NEW BOOKS ON CHEMISTRY.

(1) *Outlines of Theoretical Chemistry.* By Prof. F. H. Getman. Pp. xi+467. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 15*s.* net.

(2) *A New Era in Chemistry.* By H. C. Jones. Pp. xii+326. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(3) *The Progress of Scientific Chemistry in our own Times, with Biographical Notices.* By Sir William A. Tilden. Second edition. Pp. xii+366. (London: Longmans, Green and Co., 1913.) Price 7*s.* 6*d.* net.

(1) As an introduction to the study of physical chemistry Prof. Getman's "Outlines" may be warmly recommended. It follows the usual order and arrangement of such subjects, dealing mainly with the physical properties of substances. It is carefully and clearly written, and most of the subjects are treated in a sufficiently simple fashion to enable a student who has completed an elementary course on chemistry to understand them without difficulty. The only question which has arisen in reading the book is whether the very brief and necessarily superficial accounts which are given of some of the topics are worth the space devoted to them. It is not merely that the account is incomplete; it has no beginning, and leads nowhere. It conveys as much information as a worn strip of ground to the lost traveller who is doubtful whether it is a pathway or not. We refer more particularly to the discussion of the properties of liquids, such as molecular volume, refraction, magnetic rotation, and so forth. The reply might, of course, be made that it is better for a student to know of the existence of such properties, even if they tell him little or nothing, than to remain entirely ignorant of them; but in a small book like this (which, by the way, seems very expensive for its size) we are of opinion that the space might be better utilised. One excellent feature of the volume is the set of problems introduced at the end of each chapter.

(2) The title of Mr. H. C. Jones's book, "A New Era in Chemistry," seemed to promise attractive reading; but we must confess that the promise has not been fulfilled. The book, which covers a period from 1887 to the present time, is partly historical, partly explanatory, and partly philosophical. The year 1887 is selected as mark-

ing the advent of a new era in consequence of the appearance of the first volume of the *Zeitschrift für physikalische Chemie*. This year affords, no doubt, an excellent point of departure; but to qualify it as "the beginning of the transition from a system into a science of chemistry" (p. 17) is surely incorrect. Granted the profound development which has taken place in the direction of physical chemistry during this period, it would be a gross misconception of the word "science" to deny the term to chemistry during the greater part of last century. If, as the author truly remarks, it is the generalisations or laws which transform chemistry from a system into a science, he assuredly contradicts his assertion when, for example, he develops the laws connected with the history of mass action. But, apart from this, there are many other statements which are equally inaccurate. One would scarcely venture to describe Stas's method as "crude" (p. 3), or to regard Prouts's hypothesis as correlating atomic weights with the physical and chemical properties of the elements (p. 4), or to represent Kekulé's benzene formula as a triangle with the carbon and hydrogen groups occupying the corners and middle points of the sides (p. 12), or to state that Le Bel's advance on Pasteur's theory consisted in showing "that optical activity is the expression of asymmetry, but that this asymmetry is of the chemical molecule"; for it was precisely what Pasteur did suggest, as anyone who has read his lectures on molecular asymmetry can scarcely fail to remember.

Sufficient has been stated to show a certain amount of carelessness in the handling of historical details; and, in regard to the elucidation of complex problems, we doubt whether any student who was not already familiar with the subject would follow the account of, for example, Berthollet's contribution to the law of mass action, or Le Chatelier's rule (p. 80), or the explanation of osmotic pressure (p. 90). The expressions "to arrest attention to the importance of," "the method was to cut and try to see what result was obtained," are not exactly elegant English, and the frequent repetition of the same word, such as "generalisation," which occurs twenty times in seven pages, point to hurried and slovenly compilation. The book is, on the whole, disappointing.

(3) The first edition of Sir William Tilden's book on the progress of scientific chemistry is too well known and appreciated for any special recommendation of the new edition, which merely brings the subject up-to-date, to be necessary. For those who may not have seen or read the earlier volume, it may be stated that it sets forth the main facts and theories of chemistry in historical sequence, and traces the development of the various branches of the science down to the present time. The subjects are not discussed with any great detail or elaboration, but the style is fresh and attractive, and the explanations clear and incisive, so that the merest tyro in chemistry can easily follow all that he reads. With one notable exception it would be difficult to find anyone at the present day whose long association with chemistry both as teacher and investigator, and whose personal contact with many of the great chemists of this and the latter part of last century, could better fit him for the task of a historian, and the volume will furnish not the least valuable of the many contributions to chemistry of its distinguished author.

J. B. C.

OUR BOOKSHELF.

The Makers of Modern Agriculture. By Dr. W. Macdonald. Pp. 82. (London: Macmillan and Co., Ltd., 1914.) Price 2*s.* 6*d.* net.

In this little book Dr. Macdonald has given a very pleasant and readable account of five of the makers of modern agriculture, viz., Jethro Tull, Coke of Norfolk, Arthur Young, John Sinclair, and Cyrus H. McCormick. He has carefully examined the best biographies available, and has given a summary of the lives and works of his subjects, which cannot fail to be of wide interest to all concerned in the development of agricultural science. If we have a fault to find, it is that the title is too comprehensive: Lawes and Gilbert are not mentioned, yet they must surely stand among the makers of modern agriculture, for it was they who worked out the application of artificial manures to agricultural practice. Three of the five are Englishmen, one is Scotch, and one American. Tull and Coke are in some ways the most interesting of the five.

Tull was born at Basildon in Berkshire in 1674, and did his best work in the same county. His claim to fame is that he invented the method of drilling seed, which has now displaced the older method of broadcasting or dibbling. He was thus able to secure an opportunity for cultivating land even while the crop was growing. In consequence, bare fallow could be dispensed with, and the land could be utilised throughout the whole of the rotation. The principles that he laid down are wonderfully accurate, while his methods have changed only in detail and not in essentials.

Coke of Norfolk is well known for his remarkable work in the development of light, sandy soils. It is unfortunate that no satisfactory account of his agricultural experiments has yet been published, and one can only hope that this oversight on the part of agricultural writers will soon be remedied. His experiments at any rate were well known in his own day, and the practices he introduced have been widely followed ever since.

The Horticultural Notebook. Compiled by J. C. Newsham. Third edition, thoroughly revised. Pp. xx + 418. (London: Crosby Lockwood and Son, 1914.) Price 4*s.* 6*d.* net.

THE fact that this work of reference has reached its third edition, and that its price has been reduced, proves that its usefulness is now generally recognised. It is, indeed, a book of convenient size and shape, which anyone whose interests are largely bound up in horticulture will find useful to have on his writing-table. As everyone knows who follows this pursuit, minor problems are cropping up almost every day of one's life. The strength of an insecticide or a manure, some simple way of ascertaining the height of a tree without climbing it, the right dimensions of a lawn tennis court, how to make a grafting wax: these are samples of the kind of question for which those concerned with gardens are constantly needing an answer. This the "Horticultural Note-Book" sets out to supply, and we do not find that it often fails.

Although the serious student will need something more detailed than is here furnished, the book is not devoid of scientific teaching. A synopsis of the natural orders of plants, for instance, is concisely and conveniently arranged and helpful in "running down" a plant. It is not, however, in this direction (which suggests too much a shilling encyclopedia) that the value of the book consists, so much as in the collection of garden recipes and rules, and in much tabulated information. The ancient and remarkably persistent error that the plane tree of the streets is the American *Platanus occidentalis* is once more repeated here (p. 368), although it has several times been pointed out in these columns that the tree is really the Old World *P. acerifolia*.

Ornamental Lathework for Amateurs. By C. H. C. Pp. 121 + xii plates. (London: Percival Marshall and Co., n.d.) Price 3*s.* 6*d.* net.

PLAIN turning is carried out in an ordinary lathe by revolving the work and operating on it by tools held in the hand or in a slide-rest. In ornamental turning, an object already subjected to plain turning processes is ornamented by further operations carried out on it by cutters which are made to revolve independently of the lathe mandrel. Ornamental turning is an exceedingly beautiful art, and the object of the little book before us is to awaken the interest of those who have adopted turning as a hobby, and to show how simply an ordinary turning lathe may be modified so as to be capable of producing beautiful examples of ornamental turning. While many examples are given and illustrated by photographs, it is not the author's intention that these should be used as designs to be worked out, but rather to stimulate the worker to devise new designs and methods for himself. Drawings of many useful types of tools are given, mostly of a simple character. The book can be recommended as a useful introduction to any amateur turner who has not yet taken up this fascinating branch of his art.

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.*]

Rayleigh's Law of Extinction and the Quantum Hypothesis.

THE bearing of Rayleigh's law of gaseous extinction on some of the fundamental aspects of radiation theory does not seem to have been sufficiently emphasised in recent reports and publications on modern molecular physics. The coefficient of attenuation κ of radiation of wave-length λ travelling through a gas containing n_0 molecules per unit volume was given by Rayleigh[1] so long ago as 1871 in the form $\kappa = \frac{8}{3}\pi^3({\mu^2}_0 - 1)^2\lambda^{-4}/n_0$, μ_0 being the refractive index of the gas. It is of importance to notice that the law in question is one of the most fundamental results of molecular dynamics, its final expression being an invariant with respect to the theories of the æther or of the molecule employed,[2] while in its derivation there is no need to draw on resources outside classical dynamics and continuous energy-flow. From the point of view of elementary electromagnetic theory, the above expression for κ is very easily derived along lines suggested in a problem set in part ii. of the "Mathematical Tripos"[3]; use is made of the conventional electrical doublet set into forced vibrations by a train of electromagnetic waves; by making use of the radiation formula for accelerated charges and Poynting's theorem, the flow of energy from the doublet is easily calculated in terms of the amplitude of vibration; the oscillations of the doublet contribute a term to Maxwell's displacement current, enabling the amplitude to be expressed in terms of the refractive index of the gas; by considering the depletion of energy from the original beam as a result of this scattering, and eliminating the amplitude, the above expression for κ is easily obtained. In a recent paper, Natanson[4] has subjected the derivation of Rayleigh's law to minute criticism on the grounds of the classical electromagnetic theory, allowing for a damping term arising from the mechanical reaction due to radiation, and taking into special consideration the summation of the aggregate radiation from the random distribution of doublets which are supposed to constitute the molecules of the gas; the final result is a vindication of the above expression for the coefficient of attenuation to a very high order of accuracy. It may be noticed in passing that the same electromagnetic system forms the basis of Planck's[5] theory of "black-body" radiation, the interpretation of experiment in this case, however, necessitating the hypothesis of discontinuous energy-flow, or the emission of energy by "quanta."

For an adequate experimental verification of Rayleigh's law recourse must be had to observations on the extinction of solar radiation of different wave-lengths by the earth's atmosphere. The importance of the observations of the Smithsonian Astrophysical Observatory on atmospheric transmission recently carried out by Abbot and Fowle[6] in connection with their determinations of the solar constant at Mount Wilson, in furnishing material for a study of mole-

1 Rayleigh, *Phil. Mag.*, xli., pp. 107, 274, 447 (1871); "Collected Works," i., pp. 87, 104, 518.

2 Schuster, "Theory of Optics," 2nd ed. (1909), p. 325.

3 Mathematical Tripos, Part ii., June 2, 1906.

4 Natanson, *Bull. Inter. de l'Académie des Sciences de Cracovie* January 5, 1914.

5 Planck, "Theory of Heat Radiation" (Trans. by Masius, Blakiston's, Philadelphia, 1914). part iv., chap. iii. p 165.

6 Annals of the Smithsonian Astrophysical Observatory. Washington: vol. ii. (1908); vol. iii. (1913).

cular scattering was first pointed out by Schuster[7]; the question was examined in further detail by Natanson[8] and independently by the writer.[9]

If S refer to the intensity of wave-length λ outside the earth's atmosphere, and $E(x)$ to the intensity normal to the sun's rays reaching a level x above the sea from a zenith distance ζ, we have $E(x) = Se^{-C_x \sec. \zeta}$, where C_x is the coefficient of attenuation at the station in question. If allowance be made for the conversion of radiant energy into heat, it is shown by the writer that C_x may be expressed in the form $C_x = \gamma + \beta\lambda^{-4}$; β is proportional to the pressure of the atmosphere, so that if β_0 refer to standard conditions of pressure and temperature we have $\beta_0 = \beta p_0/p$, where p is the barometric pressure at the station at the time of observation. Finally, in terms of the refractive index of air under standard conditions, it is shown that $\beta_0 = \frac{8}{3}\pi^3(\mu^2_0 - 1)^2 H_0/n_0$, where H_0 is the height of the "homogeneous atmosphere" calculated at 0° C., and n_0 the number of molecules of air per cm.^{3} under standard conditions. It may be remarked that these relations may be obtained in a very general manner independently of any assumptions regarding the atmospheric gradients of temperature and pressure, provided that the planes of equal density be parallel to the earth's surface.

The accuracy of the experimental measure of the zenith transmission, $a = e^{-C_x}$, rests ultimately on the ratio of two galvanometer deflections, or the measurements of two ordinates of a bolograph record, quantities measurable to well within 1 per cent. Owing to the occurrence of the *ratio* only, corrections due to the imperfect reflecting powers of mirrors, absorption by prisms, slight reflection from the bolometer-strip, etc., do not appear. The determination of the remaining observed quantities, zenith distances of the sun, wave-lengths, and barometric pressures are all terms of the zenith transmission a, for the most part over a range of ten wave-lengths, avoiding regions of selective transmission. The average zenith transmission, $\bar{a}$, is determined for a large number of days each year; unfortunately it is not quite exact to derive the mean coefficient of attentuation as $\log_e \bar{a}$; the error committed is difficult to estimate beforehand, but will be negligible only when the attentuation coefficients are small or when they deviate very little from their mean value; actual trial shows that the error committed may amount to as much as 2 or 3 per cent. In addition, there is the probability that the constants β and γ are independent variables; for these reasons it seemed advisable to the writer to determine β and γ independently from each day's observations from the constants of the line of closest fit (calculated by least squares) corresponding to the formula $C_x = \gamma + \beta\lambda^{-4}$, taking as variables C_x and λ^{-4} measured in units chosen according to a suitable scale. The computations were very ably carried out by Mr. A. A. Scott and Mr. Etienne S. Bieler, both of McGill University, working under a grant from the Rumford Fund of the National Academy of Sciences. The daily determinations of β and γ have now been extended to all the transmission observations as yet published by the Smithsonian Astrophysical Observatory. Comparison with theory is most conveniently made by calculating n_0 according to the preceding formulæ. For each selection of wave-lengths a value of $(\mu^2_0 - 1)^2$ weighted according to λ^{-4} was employed, while the barometric pressures at the times of observation were obtained through the courtesy of Dr. Abbot.

Pending full publication and a more detailed discussion of the results obtained, a summary of the mean values of β and γ, together with the corresponding determinations of n_0, and the probable deviation from the mean is given in the following table:—

Constants of Atmospheric Absorption.

Mount Whitney, California. Elevation, 4420 *Metres. Average Barometer,* 446·7 *mm.*

Annals, vol.	Table	No.	Days	Mean γ	Mean β	Mean n_0	Wave-lengths
iii.	46	4	(1909–10)	0·014±0·003	0·0049 ±0·0001	$(2·84±0·06)\times 10^{19}$	10 wave-lengths, 0·327μ to 0·574μ

Bassour, Algeria. Elevation, 1160 *Metres. Mean Barometer,* 664·6 *mm.*

Annals, vol.	Table	No.	Days	Mean γ	Mean β	Mean n_0	Wave-lengths
iii.	46	9	(1911–12)	0·080±0·012	0·00723±0·0002	$(2·85±0·07)\times 10^{19}$	10 wave-lengths, 0·340μ to 0·532μ
iii.	46	2	(1912)	0·27 ±0·01	0·00696±0·0001	(2·96±0·03)	

The marked increase of γ in the second series at Bassour is due to the presence of volcanic haze from the Mount Katmai eruption, June 6–7, 1912.

Mount Wilson, California. Elevation, 1780 *Metres. Mean Barometer,* 623·5 *mm.*

Annals, vol.	Table	No.	Days	Mean γ	Mean β	Mean n_0	Wave-lengths
ii.	14	59	(1905)	0·052±0·002	0·00673±0·0001	$(2·82±0·04)\times 10^{19}$	4 wave-lengths, 0·40μ 0·45μ 0·50μ and 0·60μ
ii.	14	62	(1906)	0·058±0·002	0·00613±0·00006	(3·10±0·03)	
iii.	33	114	(1908)	0·076±0·002	0·00691±0·00006	(2·75±0·02)	
iii.	34	96	(1909)	0·031±0·001	0·00687±0·00008	(2·80±0·03)	9 wave-lengths, 0·35μ 0·40μ 0·45μ 0·50μ 0·70μ 0·80μ 1·00μ 1·20μ 1·60μ
iii.	35	115	(1910)	0·023±0·001	0·00696±0·00008	(2·76±0·02)	
iii.	36	113	(1911)	0·022±0·001	0·00696±0·00005	(2·76±0·02)	

The mean value of n_0 obtained by combining the results of Tables 34, 35, and 36 (324 days, 1909–11) gives $n_0 = (\mathbf{2·78_1 ± 0·01_3}) \times \mathbf{10^{19}}$. Hence we obtain for Avogadro's number the value $N = (\mathbf{6·23 ± 0·03}) \times \mathbf{10^{23}}$, and for the charge on the electron $e = (\mathbf{4·64 ± 0·02}) \times \mathbf{10^{-10}}$ e.s. units.

measurable to a high degree of accuracy, so that it does not seem too much to say that the zenith transmission can be determined over a considerable range of wave-lengths to an accuracy well within 1 per cent.

Data on atmospheric extinction recently made available by the publication of vol. iii. of the Annals of the Smithsonian Astrophysical Observatory are given in

The above determination of n_0 compares favourably with Rutherford's[10] 2·78, Planck's[11] 2·77, and Millikan's[12] (2·705±0·005), while the value recently obtained by Fowle[13] from a somewhat different treatment of the Mount Wilson data gave 2·56.

7 Schuster, NATURE, July 22, 1909: "Optics," 2nd ed., 1909, p. 329.

8 Natanson, *Bull. Inter. de l'Académie des Sciences de Cracovie*, December 13, 1909.

9 King, Phil. Trans. Roy. Soc., 212 A, p. 392, 1912.

10 E. Rutherford and H. Geiger, Roy. Soc. Proc., A, vol. lxxxi., 190 p. 171.

11 Planck, *loc. cit.*, p. 172.

12 Millikan, *Phys. Rev.*, ii., ser. 2, pp. 109–143, August, 1913: *Phys. Zeitschrift*, xiv., pp. 796–812, September 1, 1913.

13 Fowle, *Astrophysical Journal*, xxxviii., No. 4, p. 398, November, 1913.

Although the above reductions of a series of self-contained observations on atmospheric extinction yield a determination of n_0 to an order of accuracy not very much less than that of the best existing determinations, their chief interest lies in the fact that they constitute as rigorous an experimental test of Rayleigh's law as may be expected in view of the practical impossibility of securing absolutely perfect atmospheric conditions. From the value of γ may be calculated the fraction of radiant energy converted per cm. of path into thermal molecular agitation; taking a value of $\gamma_0 = 0{\cdot}032$ for air under standard conditions, it is easily shown that in a stream of radiation corresponding to the solar constant the rate of increase of temperature amounts to $0{\cdot}015°$ C. an hour.[14] As the above value of γ, even for the comparatively dust-free air above Mount Wilson, includes to a certain extent the effect of volcanic haze, it follows that in a pure gas partition of energy cannot take place at a rate greater than is represented by the above-mentioned rate of increase of temperature. We have in this case an excellent illustration of two interpenetrating dynamical systems (the æthereal system of electromagnetic waves and the molecular gaseous system) allowing of partition of energy, it at all, at an excessively slow rate compared with the rate of equalisation of energy distributions which is capable of being realised in each system considered separately. It is interesting to notice also that this rate is enormously increased by the presence of constrained molecular systems (matter in the solid or liquid state, such as dust-particles, water droplets, etc.).

Further, the experimental verification of Rayleigh's law to a high degree of accuracy is interesting in that its final expression is a result of classical dynamics and continuous absorption and re-emission of energy; from this point of view it seems to the writer that the hypothesis of emission by "quanta" cannot be universally applied to radiating molecular systems.

In this connection it is interesting to notice that in the recent theory of specific heats as proposed by Debye,[15] Born and Kàrmàn,[16] and now generally recognised as an adequate interpretation of experimental results, the interpretation of Planck's constant h has been transferred from association with the individual atom to the process whereby energy is interchanged between molecular systems vibrating under those intramolecular forces and constraints which in their integrated form determine the elastic properties of the solid state. Similarly in view of the above-mentioned verification of Rayleigh's law it is difficult to see how Planck's "quantum" can be associated with the individual molecule, at any rate for that system of vibrations which enter into the forced oscillations with consequent re-emission of radiant energy thus constituting the phenomenon of molecular scattering. In the opinion of the writer one might with advantage seek for the interpretation of Planck's h in the problem of "black-body" radiation in the fact that the radiating units probably perform vibrations under the intramolecular forces and constraints which determine the solid state, while at the same time the reaction of the total aggregate of radiating systems must profoundly modify the character of the radiation from the original sources before it emerges from the interior of the solid into free space for experimental examination.

LOUIS V. KING.

McGill University, June 6, 1914.

14 King, *loc. cit.*, p. 394.
15 Debye, *Ann. der Phys.*, iv., 39, p. 789. (1912.)
16 Born and Kàrmàn, *Phys. Zeitschr.*, xiv., p. 15; also p. 65. (1913.)

The Destruction of Wild Peafowl in India.

MAY I direct attention to the subjoined extract from the *Englishman* of Calcutta of June 4 last? It will give some idea of the degree to which wild peafowl are being destroyed in India so long as the open market for foreign plumage exists in the maritime countries of Europe. Of course, there is no objection whatever to the use of peacocks' feathers in any form of art, but sufficient for the purpose should be obtained from the millions of domesticated peafowl in Europe, Asia, America, and North Africa, without pursuing a war of extermination against the wild species still remaining in India. The peacock sheds his wondrously beautiful tail feathers every summer or early autumn, but I have reason to think that the bulk of the peacocks' plumes exported from India are derived from wild birds shot for the purpose. Mr. C. William Beebe, of the New York Zoological Society, has already directed attention to the extent to which the peafowl of India and Burma are being eliminated from the woodland. One would only ask in this case control of the destruction within reasonable limits.

H. H. JOHNSTON.

"On Tuesday, the Calcutta Customs authorities seized forty-four large cases containing peacock feathers on one of the steamers. These cases were to be delivered at Hamburg. By a mere chance, they escaped detection when first presented before shipment at the Customs office, but when they had been placed on board the steamer, information reached the Customs authorities as to their contents. Promptly, Customs officers were sent to bring back the cases to the office, where on examination they were found to contain peacock feathers.

"The feathers will of course be confiscated and the exporter, whose name was not disclosed, will, if found, be fined heavily. This consignment of feathers, in a way, constitutes a record. A feather which costs half an anna in India brings in a very considerable sum in Germany.

"It is stated that cases of smuggling feathers are now again becoming very common, and the Customs officers are almost daily making seizures of the contraband article. In spite, however, of their vigilance in some cases, the smugglers succeed in sending away feathers. The smugglers employ ingenious methods; in many instances they send the feathers under assumed names; then the consignee's name is also very difficult to ascertain and in some cases, where valuable feathers are concerned, the smugglers send them by post in letters or as registered parcels.

"There is at the present moment a large demand for peacock feathers in Europe, and the majority of the consignments detected in Calcutta contained feathers."—The *Englishman*, June 4, 1914.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

MORE than three hundred members of the British Association (including some forty foreign and colonial members) are on their way to Australia to attend the eighty-fourth annual meeting, which begins in Adelaide on August 8. The Australian organisation has found it possible to offer hospitality to the whole party without distinction, and the State Governments are providing all the visitors with passes over their respective railway lines during the time of the official meeting. A number of leading members have already been for some time in the country for purposes of research, and others will remain for some weeks or months after the proceedings terminate in Brisbane on September 1. In the desire that the visitors should spend their few week-ends in acquainting themselves with extra-metropolitan activities and possibilities, a heavy programme of tours has been arranged, and upon these all members from overseas will be the guests either of the particular central State organisation concerned or of a committee in the locality visited. It is unfortunate from many points of view that it has been necessary to hold the meeting in one of the Australian winter months, for much of the pleasure of the excursions will depend upon the chances of the weather.

The Western Australian advance party of seventy began work in Perth on July 28. In a previous article a summary was given of the places to be visited by the various divisions of the party. Public lectures will be delivered by Profs. W. A. Herdman (Liverpool) and A. S. Eddington (Cambridge), Dr. A. D. Waller (London), Mr. Henry Balfour (Oxford), and Mr. C. A. Buckmaster (London).

On August 8 the whole party from overseas will assemble in Adelaide. Twenty mineralogists and chemists will leave at once for Port Pirie and Broken Hill, the most famous smelting and mining centres in Australia. As guests of the manager of the Broken Hill Proprietary Company and of the Broken Hill Mining Managers' Association they will spend four very strenuous days before rejoining their colleagues in Adelaide. At the first evening discourse to be delivered by the retiring president, Sir Oliver Lodge, the chair will be taken by the Governor of South Australia (vice-president), who will officially welcome the Association to the State. Sir Oliver Lodge has taken as his subject "The Æther of Space." The second discourse will be by Prof. W. J. Sollas (Oxford), while Prof. E. C. K. Gonner (Liverpool) will deliver a Citizens' Lecture. Sectional presidential addresses will be given in geography and agriculture. The social engagements of the stay in Adelaide include a reception by the Governor and a ball by the mayor.

The sectional work proper begins in Melbourne, where the party will arrive in three special trains on August 13. Presidential addresses will be delivered in the sections of physics and mathematics, chemistry, zoology, economics, and physiology. Both here and in Sydney the sectional sessions will be devoted largely to discussions upon broad problems. Among the subjects to be brought forward are the structure of atoms and molecules, metabolism, the nature and origin of species, wireless telegraphy, the physiography of arid lands, some antarctic problems, mimicry in Australian insects, town planning, is Australian culture simple or complex?, the study of native culture in relation to administration, climate from the physiological point of view, anæsthetics, the origin of the angiosperms, the literary side of education, vocational education, irrigation and dry farming. Town planning will be a leading feature of the work of the economics section, and the plans for the new federal capital have been lent to the section by the Commonwealth Government. To those economists whose interests lie in current practical politics, the fact that Australia will, throughout the meeting, be preparing for a General Election early in September may offer some attraction.

Melbourne being the temporary seat of Government, its social functions include a reception by the Governor-General and the Federal Ministry, to be held on the first night of the meeting. In addition, the State Governor and Government and the Lord Mayor will entertain the Association. Prof. Bateson will deliver the first part of his presidential address, and discourses will be given by Prof. E. B. Poulton (Oxford) and the Astronomer Royal, and Citizens' Lectures by Prof. H. B. Dixon (Manchester) and Dr. W. Rosenhain (National Physical Laboratory).

The long journey of 600 miles to Sydney will be made during the night of August 19, and on the evening of the following day will be delivered the second part of the presidential address. The public lecturers in Sydney are Sir Ernest Rutherford, Prof. Elliot Smith (Manchester), Prof. Benjamin Moore (Liverpool), and Prof. H. H. Turner (Oxford). In the sections, besides discussions and papers there will be presidential addresses in geology, engineering, anthropology, botany, and education. The lighter side of the programme includes a luncheon by the State Government and entertainments by the State Governor and the Senate of the University, and a ball by the Lord Mayor.

After the Sydney session the overseas party divides. Some seventy proceed to New Zealand, while some 200 travel further north on a twenty-eight hours' journey to Brisbane. Here Mr. A. D. Hall (agriculture) and Prof. E. W. Brown, of Yale (cosmical physics), will address their sections, and public lectures will be given by Profs. H. E. Armstrong and G. W. O. Howe (London), Dr. A. C. Haddon (Cambridge), and at the last meeting, Sir Edward Schäfer. Social entertainments have also been arranged. It is likely that in most of the capital cities the universities will confer degrees *honoris causa* upon a few of the leading members of the visiting party.

It is not possible adequately and briefly to summarise the excursions programme. The organisation has endeavoured to include those localities most suitable from the point of view of the professional interests of the guests, at the same time not failing to include some places of chiefly scenic attraction. The limits imposed by the necessity for easy accessibility and by the exceedingly short time at disposal in any one State, have made the task very difficult. A wide and probably rather embarrassing choice will be open to the visitor, but except for those members who can remain in Australia after the meeting it will seldom be possible to journey very far from the coastline. The names of most of the places to which excursions have been planned have already been mentioned in a previous article.

Literature in abundance has been prepared for the use of members. The Federal Handbook gives general accounts of the scientifically important aspects of the country, and it was some time ago placed in the hands of prospective visitors. It is the intention of the Commonwealth Government also to present a copy to each member of the general committee and to each foreign corresponding member. An admirable supplement to this work is given by the handbooks issued by the respective States, and by booklets which deal specifically with the localities chosen as objects of excursions.

It is a misfortune that so great a proportion of the time which members can spare from their work in Great Britain must be spent on the ocean; but it may be conceded that the proposed arrangements in Australia, if successfully carried through, will have offered to the visiting party as full and well-chosen an opportunity for achieving the objects of a colonial meeting of the British Association as it is possible to obtain in the short space of three and a half weeks, devoted to visiting four cities distributed along a stretch of railway line 1800 miles in length.

THE ELECTRIC EMISSIVITY AND THE DIRECTIVE DISINTEGRATION OF HOT BODIES.

THAT department of physics which concerns itself with the electrical and kindred properties of incandescent bodies has recently attracted a good deal of controversial attention. From the outset, the subject aroused great interest, possibly in view of its speculative possibilities for solar physicists and others, and numerous workers have carried its development into great detail and some complexity. In a short *résumé* of the two phenomena specifically mentioned in the title of this article, we can do no more than touch on general outlines. Of the several aspects, the electrical one, now generally known as "thermionics," calls for first mention.

Electric Emissivity.—It was Guthrie in 1873, at the Royal School of Mines, who did pioneer work on what we now know to be a characteristic feature of incandescent bodies, and that is, to put it simply, their property of emitting an excess of positive electricity at a red heat, and at higher temperatures, a much larger excess of negative. The positive electrification, we have reason to believe, is carried chiefly by atoms or molecules of either occluded gas (such as CO), or impurities such as the alkali metals.

The degree of the negative emissivity at high temperatures was shown by subsequent workers, Elster and Geitel among others, to depend not only on the body and its temperature, but also on the nature and pressure of the surrounding gas. Sir J. J. Thomson established the fact that no matter what the nature of the hot body, the electron was the prime agent in the transport of the negative electricity; and later, Prof. O. W. Richardson (then a student at the Cavendish Laboratory), in his early work on a subject now associated with his name, concluded that these thermionic currents were due to a kind of "electric evaporation" of the unattached electrons in the solid.

Treating the problem from this point of view, Richardson derived his well-known expression:—

$$I = a\theta^{\frac{1}{2}}e^{-b/\theta},$$

where I is the saturation current, θ the absolute temperature, and a and b are constants for any particular material. As will be seen, the formula (which is identical in type with that of Kirchoff for vapour-pressure, and shares its peculiar "elasticity") contemplates the electric emission as due solely to the effect of temperature.

It was not until 1912 that doubts were first cast on the adequacy of this explanation. Pring and Parker (*Phil. Mag.*, January, 1912), working in Sir Ernest Rutherford's laboratory at Manchester, took especial pains to purify and free from gas a sample of carbon rod, and in consequence of these precautions found that the thermionic emission from the rod in a high vacuum was reduced to a value of the order of a million times smaller than was indicated by Richardson's formula. Later, Pring (Proc. Roy. Soc., November, 1913) continued and refined these experiments, and succeeded in further reducing the ionisation currents.

Clearly, Richardson's constants for carbon needed amending, as he himself readily recognised, though the two investigators still find themselves in disagreement (Richardson, Proc. Roy. Soc., May, 1914) as to the extent of the correction which is afforded by Pring's experiments.

This point remains at issue, but the further observations of Pring on the effect of introducing traces of different gases into the vessel containing the carbon strongly favour his contention that the thermionic currents owe their origin, at any rate in great part, to an interaction, probably of a cyclic character, between the carbon and the surrounding gas. Pring tried a number of gases —helium, argon, nitrogen, carbon dioxide, etc.— and found that the ionisation effects at very low pressures followed closely the order of the known chemical activities. It may be noted that Fredenhagen, working about this time on sodium and potassium in a high vacuum, also concluded that the thermionic effect was a chemical one.

In the meantime, Harker and Kaye (Proc. Roy. Soc., February, 1912), at the National Physical Laboratory, had approached the question from quite another point of view. With the object of accentuating these high-temperature currents, they had recourse to the carbon-tube resistance furnace. Under these conditions they obtained electrical emissions of unparalleled magnitude from carbon at atmospheric pressure, no electromotive force being applied. At temperatures approaching 3000° C. the thermionic current attained a value of several amperes, and readily lit up a nest of small glow-lamps; it was no longer a question for electrometer or sensitive galvanometer. These investigators concluded that the effect in their experiments was largely conditioned by the furnace-gas and the expulsion of the impurities present in the carbon. In more recent work, Kaye and Higgins have extended these furnace experiments to the case of the alkaline earths and a number of metals. When these substances were suddenly introduced into the furnace, even more remarkable electric currents were recorded, amounting at 2500° C. to about 4 amperes per sq. cm. with barium oxide, about 2 amperes per sq. cm. with boiling tin, and rather less with boiling iron.

Without a doubt, the emission with baryta is one owing its magnitude in great part to chemical action; and this view, it may be noted, tallies with the opinion now generally held that the activity of this substance (and of lime) in the Wehnelt kathode, is effected largely through the intermediary of the residual or occluded gas, or possibly of the platinum kathode.

These conclusions as to the part played by the surrounding gas are on all fours with the results of recent work by Fredenhagen and Küstner (*Phys. Zeit.*, January 15, 1914), and Hallwachs and Wiedmann (*Berl. Ber.*, January, 1914) on the photo-electric effect. These observers took steps to renew continuously (either by scraping or distillation) the surface of a metal (Zn and K respectively) in a vacuum of exceptional excellence, and then found that, if elaborate precautions were taken to remove any occluded gas as fast as it was released, no electronic emission such as is ordinarily produced by ultra-violet light could be detected. The inference is that chemical action plays a prominent part in photo-electricity, just as in many thermionic experiments.

But there are certain cases described by Richardson and his coadjutors, and more recently by Langmuir (*Phys. Rev.*, December, 1913), where the temperature factor is apparently competent to explain quantitatively the observed phenomena; and the present position appears to be that several effects may be concerned in the generation of electricity by hot bodies, viz.:—

(1) That due purely to temperature;

(2) That due to chemical reaction; and probably

(3) That due to a change of state—volatilisation and possibly liquefaction.

It does not follow that all the various causes will conspire to help each other. For example, Kaye and Higgins noticed that boiling brass gave out at 2500° C. a large emission of positive electricity, and it may be that in this case the vaporisation effect was positive and sufficiently great to mask completely the negative emission due to other causes.

The part played by volatilisation has not received so much attention as the others, but the experiments at the National Physical Laboratory offer support in favour of this view, which, after all, is but an extension of what is well known in cases of bubbling and splashing of liquids at moderate temperatures.

The Directive Volatilisation of Metals.—Evidence of the volatility of metals at temperatures well below their melting points is of long standing. A familiar illustration is furnished by the blackening of tungsten and carbon filament lamps. Deposits of definite outline can often be detected on the bulbs of the lamps, and the blackening frequently takes the form of a parallel band of deposit which is confined to the glass immediately opposite the windings of the filaments. The fact seems to point to the projection of particles in definite directions from the filament.

We are led to the consideration of a number of researches, which have established the fact that the particles which are given off from the surface of a metal during volatilisation tend to travel in straight lines at right angles to the surface. This rectilinear emission appears to have been first noticed by Dunoyer (*Comptes rendus*, 152, p. 592) at Paris in 1911. In his experiments a piece of sodium metal was placed at the bottom of a vessel which was highly exhausted. Above the sodium were mounted two parallel screens, in each of which was a small hole, the one being vertically above the other. The sodium was heated to about 400° C., so that the liquid metal was vaporising freely, though not actually boiling. Dunoyer found that if a small obstacle was placed above the upper diaphragm a shadow (with umbra and penumbra) was clearly traced out in the deposit of sodium condensed on a screen above the upper diaphragm. Evidently the metal was propagated in straight lines, and Dunoyer looked to the individual molecules as the carriers of the metal, these molecules being able to maintain a straight course owing to the low gas pressure.

But similar experiments carried out by Reboul and de Bollemont (*Journ. de Phys.*, July, 1912) cannot be quite so simply explained. These experimenters mounted vertically within an electric furnace two small sheets of metal facing each other and a few millimetres apart. One sheet (which was usually of platinum) acted merely as a receiving screen, while the other consisted of the metal the volatilisation of which was being studied. With the furnace below 400° C., no results were obtained; but at temperatures between 400° C. and 900° C. it was found that if the volatilising sheet was of copper or silver, a black deposit, which closely followed the shape of the emitting metal, was obtained on the screen. The extent of the effect increased rapidly with the temperature. In air at atmospheric pressure the best results were secured at about 1 mm. distance, 3 mm. being the greatest distance at which definite deposits were secured.

Fig. 1 shows the cruciform deposit obtained in air at atmospheric pressure from a copper sheet cut in the form of a small cross. In this example, the furnace temperature was 850° C., the range 1 mm., and the time of exposure 30 secs.

Reboul and de Bollemont repeated the observations under various conditions. In oxygen the effect was enhanced; in a vacuum, the deposit gained in sharpness of outline. Curiously enough, in hydrogen, the edges of the strip seemed to be the only active regions, so that the deposit merely reproduced the outline of the strip.

Kaye and Ewen (Proc. Roy. Soc., June, 1913), using an arrangement not very dissimilar to that of Dunoyer, obtained some interesting "shadow" deposits with iron. One of these, illustrated full size in Fig. 2, shows the image obtained by the normal interposition of two square-holed diaphragms between a screen and a strip of iron heated electrically in a vacuum to 1000° C. for a few hours.

This rectilinear projection is probably closely associated with what is sometimes termed sputtering, *i.e.*, the expulsion of molecules, not singly, but in relatively large aggregates, from the surface of hot metals. These projected particles would, owing to their greater mass, be less liable to scattering at high pressures by the surrounding gas molecules, and so would preserve their direction of flight longer than particles with dimensions not far from molecular.

FIG. 1.—D posit cast y heated copper strip, cruciform in shape, on screen 1 mm. away.

Fig. 3 is a photomicrograph (taken by Mr. Ewen, *Zeit. f. Metallographie*) showing the pits which developed in the surface of a specimen of wrought iron when heated for about 4 hours at 1000° C. in a vacuum.

There are grounds for suspecting that the mechanism of sputtering is partly electrical, for it was found that the passage of the heating current through the specimen itself predisposed the metal to more rapid disintegration than if it

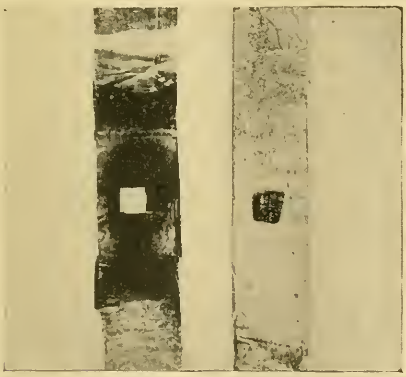


FIG. 2.—Photograph of diaphragm (on left) and iron deposit cast by it. Full size.

were heated under the same conditions in a furnace.

The practical study of high-temperature furnace experiments on thermionics finds *raison d'être*, if such were needed, in its applicability to the problems of solar electricity. If it may be regarded as legitimate to extrapolate from the results obtained over the range of temperatures (up to 3000° C.) possible in the carbon resistance furnace, then it would appear that at the estimated temperature of the sun (5500° C.) the electrical emissions would amount to many millions of amperes. Thus, notwithstanding the gigantic areas of sun-spots, there is no difficulty in accounting for the enormous currents necessary to produce the magnetic fields (from 2000 to 5000 gauss), which Hale has shown to be associated with the whirlpools in sun-spots. On the same lines, we may seek to explain also the sun's general magnetism, the vertical component of which at the poles is estimated by Hale at about 50 gauss.

In conclusion, we may refer briefly to two practical developments of the study of the molar and electric emissions from hot metals. The half-watt lamp and the new Coolidge X-ray tube are first-fruits culled by observers equipped with a knowledge of the results of pure research, and

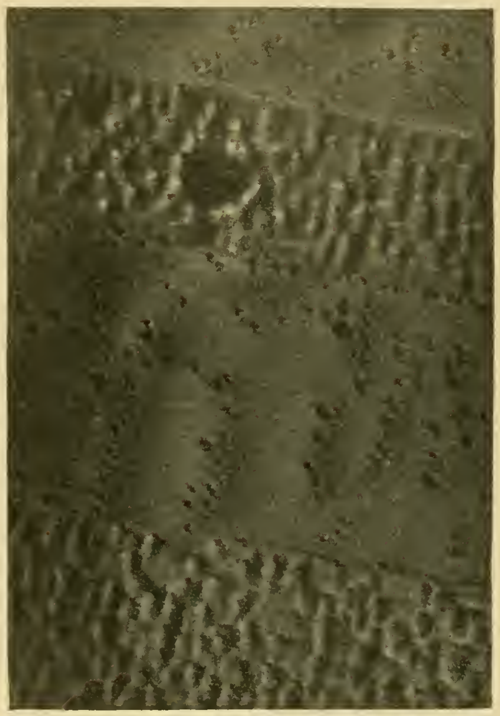


FIG. 3.—Photomicrograph of surface of iron strip which has been heated *in vacuo*, showing pits produced by volatilisation. ×1400.

an ability to apply them to industrial requirements. The work, carried out at the General Electric Co.'s research laboratory in Schenectady, is worthy of the attention of those among us who, severely practical and immediately utilitarian, seek to deprecate the study of pure science in this country.

G. W. C. KAYE.

A FORGED "ANTICIPATION" OF MODERN SCIENTIFIC IDEAS.

IN the 1913 presidential address to the Linnean Society, noticed in NATURE for January 22, 1914, Prof. Poulton gave an account of an American booklet by G. W. Sleeper, dated 1849. The work, if genuine, was an extraordinary anticipation of many modern conclusions on evolution and the germ theory of disease. The booklet itself had been sent, early in 1913, to the late Dr. A. R. Wallace by a Mr. B. R. Miller, who stated that he had bought it at a second-hand book store in 1891 or 1892. Prof. Poulton had also heard of the existence of three other copies in the possession of the author's son, Mr. J. F. Sleeper. It was pointed out in last year's address that the work was not registered, as stated; that the word "agnostic," introduced by Huxley in 1869, was used in its pages; and that there was no reference to it in an undoubtedly genuine but commonplace pamphlet published by the author in 1860. Nevertheless, the get-up of the booklet appeared to be so genuine and the style so convincing that many critical authorities were by no means convinced that it was a forgery.

Prof. Poulton, having directed attention to the subject, felt that he must make every effort to produce a body of evidence which would finally decide the question. The investigation, which could not be hurried, was only complete by Easter of the present year, and its results were communicated to the Linnean Society in the anniversary address on May 25 last. The evidence then presented to the Fellows will doubtless lead to the undisputed conclusion that the work is a forgery, and probably a very late forgery.

The Type.—Mr. J. W. Phinney, manager of the American Typefounders' Company, Boston, after an exhaustive inquiry, concluded that it was "impossible that the title-page could have been set at the date claimed for it."

The Contract with the Printer.—This document, forwarded by Mr. J. F. Sleeper, satisfied many authorities, but aroused the suspicions of Prof. C. H. Firth and afterwards of Sir Frederick Kenyon and Sir George Warner. The printer's signature, dated 1890, kindly sent by his daughter, Mrs. Endicott, was similar to that appended to the contract. It was submitted to Sir George Warner, who thought it "very remarkable that after so long an interval as forty years the signatures should be so precisely identical," and considered it "almost easier to believe that the early one is a forgery from a considerably later example." A little later Mrs. Endicott succeeded in finding another late signature also similar to that of the contract, and two early ones, dated 1856 and 1858, in both of which the B of Bense was very differently formed. It was evident, as Sir George Warner had predicted, that the signature of the contract had been copied from a late signature of the printer, W. Bense.

Other evidence of falsification was also submitted to the meeting, and will appear in the pages of the Society's Proceedings. It was suggested in conclusion that the author, self-deceived as to the importance of his own ideas, really believed that he had forestalled many conclusions of modern science. In this way he might defend the falsification of evidence as the only means by which justice could be done not only to himself but to the history of thought.

A similar interpretation might be offered if we suppose—and many reasons were given for the belief—that the forgery was committed after the author's death by one who knew his feelings and shared his delusion that he was the victim of injustice.

THE LANGLEY FLYING MACHINE.

EXPERIMENTS made in May last, at Hammondeport, U.S.A., recall the great share which Prof. S. P. Langley had in the development of aviation, the occasion being the testing of a power-driven man-carrying aeroplane designed and constructed by Langley many years ago. The aeroplane was completed in 1903, and in September and December of that year two attempts were made to launch it from the top of a house-boat on the Potomac River, but owing to defective apparatus the aeroplane and pilot fell into the river. The experiments were discontinued owing to lack of financial support, and the rescued flying machine was carefully cleaned and preserved in the Smithsonian Institution. Now, eleven years later, with floats added to replace the launching apparatus, actual flight has been obtained on the aeroplane substantially as designed except for the floats. The engine weighed only 125 lbs., and actually developed 52 horse-power, a relation of weight to horse-power roughly equivalent to that of the first successful Gnome engine.

The actual flights have so far not exceeded ten seconds, and cannot therefore be considered as conclusive evidence of the satisfactory nature of the Langley design; the results must, however, be considered in reference to the alterations made this year preparatory to the new tests. The design was for a man-carrying aeroplane having a total weight, including pilot, of 830 lbs., whilst the addition of floats and the necessary structure to support them raised the weight to 1170 lbs., and appreciably increased the head resistance. If a launching device of the character first used by the Wright Brothers had been adopted, it is probable that to Langley would have gone the credit for the first successful aeroplane.

NOTES.

We regret to have to record the death, in his sixty-sixth year, of Dr. R. J. Anderson, professor of Natural History, Geology, and Mineralogy at (Queen's) University College, Galway.

Lord Welby has been elected president of the Royal Statistical Society for the session 1914–15.

Mr. Marconi has had the order of the Honorary Grand Cross of the Victorian Order conferred upon him.

The Council of the Royal Society of Arts has received from Mr. R. Le Neve Foster a donation of 100*l.* for the purpose of founding a prize in memory of his father, the late Mr. Peter Le Neve Foster, who was secretary of the society from 1853 to 1879.

It was decided at a meeting of alpinists held at Zermatt on Saturday last to commemorate the 50th anniversary of the first ascent of the Matterhorn (falling on July 14 next) by the erection of a marble statue of Mr. Edward Whymper at the age he was when he first climbed the Matterhorn. The pedestal is to be of granite taken from the Matterhorn and the monument is to face the peak. The memorial will also commemorate Lord Francis Douglas, Mr. Hadow, the Rev. C. Hudson, and the guides, Michel Croz and the two Tangwalders. The cost will be borne by subscriptions. Mr. Justice Pickford, president of the Alpine Club, is to be invited to become the honorary president of the memorial committee. Dr. A. Seiler was appointed treasurer, and Mr. J. Grande, of Berne, honorary secretary.

The gold medal of the Royal Institute of Public Health for the present year has been awarded to Dr. James Niven, of Manchester. The medal is conferred annually on a public health official at home or abroad, in recognition of conspicuous services rendered to the cause of preventive medicine in the British Empire.

The first presentation of the Savill medal of the West End Hospital for Nervous Diseases has been made to Dr. Knowles Boney. The medal has been instituted to commemorate Dr. T. D. Savill, who died in 1910, whose work in investigating nervous diseases is well known.

The Toronto correspondent of the *Times* states that the revenue cutter *Bear*, with Captain Bartlett, master of the lost *Karluk*, on board, left Nome on July 23 in the hope of reaching the survivors of the Stefansson expedition, who are believed to be still marooned on Wrangel Island. The *Bear* carries provisions for the relief of the marooned party, as it is calculated that their food supply will be exhausted by the middle of next month, after which they will have to depend on game.

The sixth International Dental Congress—the first to be held in this country—will take place in London next week. It will be formally opened by the Right Hon. Herbert Samuel on Tuesday next, and the meetings of the sections, of which there will be ten, will be held on Wednesday, Thursday and Friday.

A meeting of the International Pharmaceutical Federation is to take place at Berne on August 7 and 8 under the presidency of Prof. L. van Itallie. According to the *Chemist and Druggist* the following are among the subjects to be discussed:—The report of the International Committee on Pharmacopœias; a suggestion to appoint a committee to report on the question of the unification of the nomenclature of pharmacopœias; a proposal to publish a uniform table of the specific gravities of mixtures of alcohol and water; a report on pharmaceutical education; the need of a permanent commission to take charge of the organisation of the International Congress of Pharmacy; organisation of a Press bureau; and a conference having for its object the standardisation of formulæ produced for the purpose of replacing pharmaceutical specialities.

The eighth meeting of the Italian Society for the Advancement of Science will meet at Bari on October 8–13, 1914, under the presidency of Prof. Camillo Golgi. The secretary is Prof. Vincenzo Reina. The congress is divided into three classes: Class A, physical and mathematical sciences; Class B, biological sciences; Class C, moral sciences. The opening meeting will be held in the hall of the Piccinni Theatre, when Prof. G. Cuboni will deliver an inaugural address on "The Problems of Southern Agriculture." Addresses will be delivered before the conjoint sections by Prof. Coletti on "Tripoli and its Social Structure"; by Prof. Nasini on "What has disappeared and what has been retained or transformed in chemical theories of the past century"; and by Prof. Sergi on "Eugenics in relation to biology and sociology." Amongst the papers to be read before the special sections, the following may be noted: The exploration of the upper atmosphere, by P. Gamba; practical generators of electro-magnetic waves, by Q. Majorana; the progress of dynamics in engineering technics; immunity, by M. Ascoli; muscular contraction, by F. Bottazzi; the progress of psychiatry, by A. Cerletti; internal secretion and anatomical structure, by R. Fusari; vaccinotherapy in typhoid, V. Pensuti; the origin and significance of alternation of generations in plant ontogeny, by R. Pirotta; the chlorophyllian pigments, by F. Plate; internal secretions from the physiological standpoint, by I. Solvioli; the war against harmful insects, by F. Silvestre; a series of papers in political and moral science, by different authors, is also included in the provisional programme.

The seventh International Aeronautical Congress is to be held at the Lyons Exhibition from September 27 to October 1 next, under the presidency of Lieut.-Col. P. Renard.

The second annual meeting of the Indian Science Congress is to be held, under the auspices of the Asiatic Society of Bengal, in Madras on January 14–16 next. The president will be Hon. Surgeon-Gen. Bannerman. The secretary of the local committee is Dr. J. L. Simonsen of the Presidency College, Madras, and all communications respecting the congress should be addressed to him.

A congress of engineers is to take place on September 20–25, 1915, at San Francisco, Cal., U.S.A., in connection with the Panama-Pacific Exhibition. It will be presided over by Col. G. W. Goethals. One of the chief features of the congress will be the reading of a number of papers dealing with the Panama Canal. These contributions will be presented under twenty-two heads, and will include a general report by Col. Goethals.

Next year's conference of the British Pharmaceutical Society is to be held at Scarborough under the presidency of Mr. Saville Peck.

Among the exhibits in the food section of the Civic Exhibition now held in Dublin is one of great interest. It was originally shown at the Dresden International Health Exhibition in 1911 and represents, in actual proportions, the cleavage products (bausteine) obtained by Prof. Abderhalden from several proteins such as caseinogen, gliadin, globulin, etc. It was lent by Prof. Abderhalden, of Halle, to Prof. W. H. Thompson, who is in charge of the food section of the Exhibition. It has never been out of Germany before, and is of such value that it is scarcely likely to visit this country again. The Exhibition will close at the end of August.

AN exhibition of gyroscopic mechanism is being organised at the Science Museum, South Kensington, and a private view was given on Tuesday last.

ACCORDING to *Science,* the American Ornithologists' Union has appointed a committee on the classification and nomenclature of North American birds. The members of the committee are Messrs. Allen, Brewster, Chapman, Dwight, Grinnell, Merriam, Nelson, Oberholser, Palmer, Richmond, Ridgway, and Stone.

THE new Sir Alfred Jones ward of the Liverpool School of Tropical Medicine at the Liverpool Royal Infirmary was opened by Lady Derby on Thursday last, and was followed by a luncheon at which Sir Thomas Barlow spoke highly of Sir Alfred Jones. He said the numerous expeditions of the school, carried to the very homes of death and disease, had afforded records full of real actual romance. Those expeditions, and protracted researches in the school, had been justified up to the hilt by actual improvement in the health conditions of the districts concerned from carrying out the lessons enforced by research. One great achievement of the school had been its instruction given in tropical medicine and hygiene to post-graduates. Instruction in tropical hygiene told a man how he could profitably begin and make provisional improvements while the larger schemes were getting under way. They had the first stage of research which happily went on, and the second stage of post-graduate teaching which would continue, and they were to take on a third function—that of bringing the study of tropical disease within the curriculum of the medical undergraduate within the school itself. The association of the study of tropical diseases with that of general medicine could not be too close and intimate. The real justification of this step was the bringing of the laboratories and the sick man close together, so that there might be the readiest possible facilities for identifying the real cause of the disease and preparing the quickest and most trustworthy methods of cure. There was no higher scientific task than to cure a sick man.

THE Special Electricity Committee of the London County Council has presented a report to the Council based upon the report prepared by Messrs. Merz and McLellan (see NATURE, April 23, 1914, p. 198). The committee recommend the promotion by the Council of a Bill in the next session of Parliament to establish a new undertaking and a new authority for the purpose of controlling its operations, which would actually be carried out by a private company, the present means of supplying electricity in and around London having been found unsatisfactory. According to the *Times* the details of the scheme are, in brief, as follow :—A new electricity authority is recommended consisting of thirty-one members, of whom the majority would represent the London County Council and the rest the surrounding county councils and county boroughs. The new authority will be empowered by Parliament to set up a new undertaking with a two-fold object : (1) The gradual establishment of large generating stations down the river from which supplies in bulk will be given to such existing undertakings as wish it. (2) The new authority will have the right to acquire by agreement existing undertakings, whether municipal or company, and combine them so as gradually to bring about one unified scheme. The area covered is 964 square miles, with a population of $7\frac{1}{2}$ millions. It contains 70 existing undertakings, and about 80 electric generating stations; 60 per cent. of the electricity sold in this area is at present produced within the county of London.

MANY instances are on record of so-called "wolf-children," said to have been found in the jungles of India. A strange story is now reported from Naini Tal, the summer capital of the United Provinces of Agra and Oudh, of a female child about nine years old found in this neighbourhood, and unable to eat anything except grass and chapatis or native griddle cakes. She has a great mat of head hair and a thick growth on the sides of her face and spine. She bears marks of vaccination and is clearly a child who had, years ago, been abandoned or strayed into the jungle. Her capture is attributed to the fact that she was suffering from an ulcerated foot, and she had also deep scars on her head and knees. The case has attracted much attention, and it will be interesting to learn the result of the physical examination of the girl which is now being made.

IN the Journal of Egyptian Archæology (vol. i., part iii.), Prof. G. Elliot Smith discusses the question of Egyptian mummies. It has been generally supposed that the history of mummification was as old as Egypt itself, and many examples of prehistoric remains were believed to have been embalmed. But when Prof. Elliot Smith found that the Cairo Museum contained no mummy earlier than the period of the seventeenth dynasty, the problem attracted his attention. There were indications from the discoveries of the so-called "canopic" jars, that the practice was very ancient; and recent discoveries confirm this supposition. We now possess examples of embalming of the tenth and twelfth dynasties, and a specimen in the museum of the Royal College of Surgeons is proved to date from the fifth dynasty, or possibly even earlier. The custom, in spite of Christian teaching, lasted until the coming of the Mohammedans in the seventh century of our era. The methods used and the gradual degeneration of the art are described in this interesting contribution.

IN the issue of Man for July Mr. Elsdon Best examines the occurrence of cremation among the Maori tribes of New Zealand. It was never practised as a general custom to the exclusion of other methods for the disposal of the dead. It was used in exceptional cases, as, for instance, when a tribe occupied open country where no suitable places for the final disposal of the bones after exhumation were available; when a raiding party, or even a gang of peaceful travellers, lost one of their members by death outside the tribal boundaries; and it was occasionally practised to stay epidemic disease. At the time of the cremation wands were set up near the pyre as a refuge for the separable soul. The custom no longer prevails, though cases are known where the corpses of British dead were burned by the natives during the last Maori war.

IN No. 4 of the second series of Bankfield Museum Notes, issued by the Halifax Corporation, Miss L. E. Start describes a collection of Coptic cloths presented by Prof. Flinders Petrie. The paper deals with Egyptian dress from the earliest times, and the evolution of the art of weaving is illustrated by excellent sketches from the monuments and by a description of the methods and appliances used. The cloths fall into five groups, of which those representing the period 320–620 A.D. are the most interesting in the series.

NORTHERN Europe has experienced a spell of unusually hot weather during July and the thermometer has, in places, been high almost throughout the month. The type of weather has been anticyclonic over Scandinavia and the adjacent regions, and winds have been very light. The observations used for the following comparisons have been culled from the daily weather reports of the Meteorological Office and a few missing readings have been interpolated. Daily temperatures for July 1 to 24 have been dealt with. The mean temperature for the whole period at Haparanda, at the head of the Gulf of Bothnia, and in close proximity to the Arctic Circle, is 66·4°, which is 1·6° warmer than the mean in London, and 3·8° warmer than the mean at Bath. At Stockholm the mean temperature for July 1 to 24 is 73·0° and at St. Petersburg 71·1°, whilst the mean at Nice is 72·4°, and at Paris only 65·6°, or 0·8° warmer than London. The mean maximum or highest day temperature at Stockholm is 82·1° and at St. Petersburg 80·2°, whilst in London, where the temperature has been in excess of the average, every day at Greenwich, from July 1 to 22, having a temperature above 70°, the mean maximum at Kew was 72·9°. Haparanda was warmer than London on 15 days out of the 24, and St. Petersburg was warmer than London on 21 days, and on two days the sheltered thermometer touched 90°. On five consecutive days, July 3 to 7, the temperature at Bodö, within the Arctic Circle, exceeded that in London, and was above 80° from July 5 to 7. Stockholm was warmer than Bath on 23 days. The colder weather which was being experienced over the British Isles during the closing week of July had also extended somewhat to most other parts of Europe, and the highest day temperature in the northern regions had dropped to about 70°.

ACTING on the advice of the French resident, the King of Annam has recently issued an order prohibiting the slaughter of the wild elephant in the protectorate of Annam. The capture, domestication, and sale of these animals will be permitted under certain regulations.

DR. ALEXANDER IRVING has reprinted, from the Transactions of the Hertfordshire Natural History Society (vol. xv., part 3, May, 1914), an account of recent discoveries of prehistoric horse remains in the valley of the Stort. He concludes that the specimen discovered has the vertebral column of the zebra and of the forest type of horse, and differs in this respect from all four skeletons in the Museum of the College of Surgeons, as well as from the Prejevalsky horse of Mongolia and from horses of the Plateau type.

ANNALS of the Durban Museum is the title of a new zoological journal, of which the first number, edited by the curator, Mr. E. C. Chubb, was published on June 1. Subsequent numbers are to be issued after such successive intervals as may be found convenient. Of the four articles in the present issue, the longest is one by the editor on a collection of some 2500 South African birds' eggs, representing 308 species, brought together by the late Mr. A. D. Millar; it is illustrated by a coloured plate. In a second article, on the bottle-nosed dolphins, or porpoises, of the genus Tursiops, Mr. F. W. True directs attention to the fact that the proper name of the typical species is *T. truncatus*, and not *T. tursio*, the latter specific designation having been originally applied to a larger cetacean from Greenland waters, where there is no evidence of the occurrence of a bottle-nose of any kind.

THE June number of *Naturen* contains a fully illustrated description of the up-to-date hatchery for sea-fishes, which has recently been established at Flödevigen, on the Skagerak, and is now in full working order. In addition to the more important apparatus used in the hatchery, the illustrations include photographs of very young torsk at various stages of development. Many millions of these valuable food-fishes were hatched last year.

As the result of two exploring cruises, Mr. James Hornell is enabled to report (in Bulletin No. 8 of the Madras Fisheries Bureau) the existence off the Tanjore coast of Madras of a trawling-ground of far higher value than any of those off the coast of Ceylon. It comprises a large plateau lying within the hundred-fathom line off Cape Comorin, and appears to be the resort of numerous bottom-feeding food-fishes, which are at present fished only in a desultory manner by natives with the line. Among these fishes are vast shoals of the great oyster-eating ray (*Rhinoptera javanica*), which inflicts such serious damage to the pearl-oyster banks. In a second article in the same issue Mr. Hornell shows that these and other fishes (most of which devour only the immature molluscs) are the real cause of the great periodic fluctuations in the fertility of the pearl-oyster beds of the Gulf of Manaar, which have long puzzled experts. Suggestions for dealing with the evil are appended.

EXPERIMENTS on the inheritance of bodily size in tame rabbits form the subject of an article by Mr. E. C. Macdowell, published by the Carnegie Institution of Washington. The details are, however, so complex and involved that it is impossible to give a summary of the results within the limits of a paragraph.

THE Scottish Zoological Park has received a collection of East African animals, for the most part antelopes, the gift of Mr. H. S. Pullar, of Bridge-of-Earn.

IN his presidential address to the annual meeting on January 22 (as reported in the society's Proceedings for 1913–14) Mr. A. E. Tonge was enabled to congratulate the South London Entomological and Natural History Society on its flourishing condition, the number of new members added to the roll during 1913 being about double those removed. The attendance at the field and ordinary meetings was, on the whole, satisfactory; an important addition has been made to the society's collection of British Lepidoptera; and the number and quality of the papers read (which are illustrated by nine plates) were considerably above the average.

CONSIDERABLE additions to the British fauna are made in the July number of the *Entomologist's Monthly Magazine,* Dr. Sharp adding a Continental chrysomeline beetle (*Dorcatoma punctulata*), taken near London, Mr. James Edwards several new species of the minute insects of the family Typhlocybidæ, chiefly from Nottinghamshire, and Mr. A. E. J. Carter three species of Diptera hitherto known only from the Continent.

IN an article published in *Naturwiss. Wochenschrift* of July 5, Dr. E. Hennig directs attention to the extraordinary number of dinosaurian remains obtained in Germany and her East African colonies during the last lustrum. The most important of these discoveries have been made in the Keuper of Halberstadt and the corresponding formation of Trossingen and Pfaffenhofen, Württemberg, and in the Jurassic and Cretaceous strata of Tendaguru and other parts of German East Africa. To the remains from Tendaguru reference has been made already on more than one occasion. The dinosaurian finds from the Swabian Trias formed the subject of a communication made by Dr. E. Fraas at the eighty-fifth *Versammlung deutscher Naturforscher und Aerzte* in September, 1913, and Dr. O. Jaekel has described the discoveries at Halberstadt in vols. i. and ii. of *Paläontol. Zeitschrift.* According to the latter communication, the removal of some 100,000 cubic metres of rock has brought to light at least one hundred dinosaurian skeletons. It may be added that two important papers on the origin and morphology of dinosaurs, by Dr. von Huene, have been published, respectively, in the *Neues Jahrb. f. Min.* and the *Zentralbl. f. Min.*, 1914.

IN the July number of *Wild Life* Mr. F. Russell Roberts, who is both a great hunter and an expert photographer, commences a series of illustrated articles on his experiences among the big game of Western and Eastern Africa, dealing in this case with the elephant. His photographs of herds of these great animals in the jungle are admirable, and well calculated to arouse in stay-at-home persons an intense desire to behold such wonderful sights. It is a pity that the locality of each photograph is not given, as if this had been done the pictures would have been of value to the naturalist in the determination of the local races of the species. If we might hazard a guess, we should regard the topmost of the two photographs facing p. 120 as representing the big sharp-eared elephant of the White Nile, and the one facing p. 112 as a central or western race.

A REPORT upon the mineral production of the Philippine Islands during the year 1912 has been issued by the Division of Mines of the Bureau of Science of the Government of the Philippine Islands. This publication is interesting both for its contents and as evidence of the progress that our American friends are making in their self-imposed task of civilising the Philippine Islands. From the economic point of view the mineral production is not important, its total value being given as 3,514,745 pesos (356,120*l.*), two-thirds of which is made up of such items as clay pots, bricks, lime, sand, gravel, etc., which are not usually included amongst mineral productions. The only mineral of any real importance is gold, of which 27,582 fine ounces were produced, valued at 118,794*l.*, this being treble the production of the previous year. It is interesting to note that there is a small production (141 tons) of charcoal pig-iron, consumed in making castings, such as pots and ploughshares, for the local market. It is greatly to be regretted that the coal output shows a very serious falling off from 20,000 tons to 2720 tons. The fact that the report is issued uncut is presumably due to the still rudimentary stage of civilisation so far attained in the Philippines.

The Canadian Department of Mines is conducting an elaborate investigation into the preparation and properties of metallic cobalt and its alloys, with the object of increasing the demand for this metal, and thus giving greater economic value to the large deposits containing it at Cobalt, Ontario. The researches are being conducted under Dr H. T. Kalmus at Queen's University, Kingston, Ontario, and the results of the first portion of the investigation have just been published in a bulletin of the Department of Mines. This portion deals entirely with the preparation of metallic cobalt by the reduction of the oxide, the reducing agents employed being respectively carbon, hydrogen, carbon monoxide, and aluminium. The results of the experiments are given with great—perhaps with excessive—detail, and show that, as might have been expected, all the above agents can reduce oxide of cobalt completely under suitable conditions; there is thus little that is new, except that the temperatures at which the reactions take place have been carefully recorded.

THREE out of every five great earthquakes occur along the borders of the Pacific Ocean, and, in the western and more active margin, one of the most sensitive districts is that consisting of the Philippine Islands. During the year 1913 there were, according to the Rev. M. Saderra Masò, 160 shocks important enough to be timed. Two of those which occurred in eastern Mindanao (on March 14 and April 18) were registered all over the world, and were followed by after-shocks too numerous to chronicle. Two other earthquakes (on August 23 and September 4) were also recorded at Formosa and Zikawei.

No. 8 of vol. ii. of the Economic Proceedings of the Royal Dublin Society contains a lecture delivered by Prof. G. T. Morgan before the Royal Dublin Society on "Modern Dyes and Dyeing." This gives an interesting review of the history of modern dyes and synthetic colouring matters. Amongst other matters, it is stated that more than 90 per cent. of the world's demand for indigo is now met by the synthetic product. A recent discovery of great interest is that made by Friedländer, who has shown that the antique dye, "Tyrian Purple," which was extracted by the ancients from several species of sea-snails, found in the Mediterranean, and was highly prized in Italy and Greece, is in reality dibromoindigo.

A VALUABLE contribution to our knowledge of the distribution of radium emanation in the earth's atmosphere is made by Messrs. J. R. Wright and O. F. Smith, of the University of the Philippines, in the February number of the Philippine Journal of Science. Working in Manila and on Mount Pauai at an altitude of 2460 metres, they found by the charcoal absorption method that the average amounts of emanation present during the eight months of observation in terms of its radium equivalent were 82×10^{-12} grams at sea-level and 19×10^{-12} grams on the mountain. In both cases the ratio of the greatest to the least amount observed was 4 to 1, and the changes were closely related to the weather. Fair weather gave high, and heavy rain low content which was especially low during typhoons. As the authors propose to continue their observations, it is to be hoped that they will attempt to trace the paths traversed by the winds which give the high and low values respectively previous to their arrival at the islands.

WE learn from the *Engineer* for July 24 that work on the reconstruction of the Quebec bridge over the St. Lawrence River is making very satisfactory progress. The entire substructure was completed last season, and the coming season will see considerable progress on the erection of the superstructure. The superstructure is constructed partly of carbon steel and partly of nickel steel, the floor members being constructed of the former, and the truss members of the suspended span, together with the greater part of the cantilever arms, of the latter material. Drawings giving the arrangement and principal dimensions of the superstructure are included in the article. The bridge is designed for 5000 lb. per lineal foot. Wind load is assumed at 30 lb. per square foot of exposed surface of the two trusses and 1·5 times the elevation of the floor, and 300 lb. per lineal foot as a moving load on the exposed surface of the train. In considering temperature stresses, the following conditions were assumed: a variation of 150° F. in the temperature of the whole structure. A difference of 50° F. between the temperature of steel and masonry. A difference of 25° F. between the temperature of a shaded chord and the average temperature of a chord exposed to the sun. A difference of 25° F. between the outer webs exposed to the sun and the inner webs of the compression members.

MESSRS. E. MERCK, of 66 Crutched Friars, London, E.C., have issued a pamphlet containing a list of the Merck chemicals now stocked in London. Considerable additions have been made to the number of articles which are kept regularly in stock, especially as regards "Merck's Guaranteed Reagents." Special labels are attached to the latter, which show the impurities from which these reagents have been shown to be free, when tested according to the well-known Merck standards. The list of stock now includes about 650 articles, and about 900 subdivisions, so that immediate delivery can be guaranteed for all the more important pharmaceutical and analytical preparations.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—The ephemeris of Delavan's comet (1913*f*) given below is the continuation of that published by Dr. G. van Biesbroeck in *Astronomische Nachrichten*, No. 4739:—

	R.A. (true) h. m. s.	Decl. (true) ° ′ ″	Mag.
July 30	5 59 6·3	+38 18 44·5	6·3
31	6 2 5·4	38 41·9	
Aug. 1	5 8·2	58 45·2	
2	8 14·6	39 18 54·3	
3	11 24·8	39 8·6	6·2
4	14 39·0	59 27·7	
5	17 57·3	40 19 50·9	
6	6 21 19·9	+40 40 17·9	6·1

The comet is situated in the region about θ Aurigæ.

ASTRONOMICAL NOTES FOR AUGUST, 1914.—The planet Jupiter will be a fine object for observation, being in opposition to the sun on August 10, and visible during the whole night.

The great red spot and hollow in the southern equatorial belt should be observed and the times of their transits across the central meridian of Jupiter taken. These may be expected to occur at the following approximate times:—

	h. m.		h. m.
Aug. 8	9 30	Aug. 20	9 23
10	11 8	22	11 1
13	8 38	25	8 31
15	10 16	27	10 9
17	11 54	29	11 47
18	7 45	30	7 38

The spot is now in longitude about 205°. Its accelerated motion since the middle of the year 1914 has caused it to lose 153° of longitude, which represents a westerly drift of about 105,000 miles. The rotation period derived from the motion of the spot was in 1910 equal to 9h. 55m. 37·4s., in 1913 it was 9h. 55m. 35·9s.

THE METEORIC SHOWER OF PERSEIDS.—During the past few years not many of the Perseids have been observed. This year they commenced early, Miss Cook at Stowmarket saw them on July 14. The maximum will probably occur on August 11, but there will also be many meteors on August 12. The moon will somewhat interfere with the success of the observations, as she rises on August 11 at 9.1 p.m., and on August 12 at 9.14 p.m., but she will be nearing third quarter, and her light will therefore not be strong. Observers should ascertain, by counting the horary numbers, when the maximum occurs, and the brighter meteors, both Perseids and non-Perseids, should be individually recorded as regards their apparent paths amongst the stars and their durations of flight.

PHOTOMETRIC TESTS OF SPECTROSCOPIC BINARIES.—Mr. Joel Stebbins gives an account of his photometric tests of spectroscopic binaries (*Astrophysical Journal*, vol. xxxix., No. 5), and it is interesting to note that the attempt has been successful. His first experiments were made in 1904, with a visual photometer; but, not succeeding in finding any new variables, he laid the problem aside for a time. The perfection of the selenium photometer has led him to renew the tests and the results are described in his paper. Using a telescope of 12-in. aperture, he has limited himself in the first instance to stars brighter than third magnitude, and arranged his programme of binaries so as to observe them at the proper times. Then he computes from the spectroscopic elements the instants when the longitude from the node is equal to 90° or 270°, and observes at these times. The observations are most difficult because of the exacting requirements, and only work on the very first-class nights is possible. Mr. Stebbins has considered that the most favourable cases for inquiry are the systems of short-period and large range of velocity, or those which have a large value for $m^3_2 \sin^3 i/(m_1+m_2)^2$. So far his observations have led him to discover four eclipsing stars, while seven other stars are considered as constant. The following table summarises his results :—

Eclipsing Stars.

Star	Period *d*	Spectrum	$\frac{m^3_2 \sin^3 i}{(m_1+m_2)^2}$
β Aurigæ ...	3·96	Ap	0·54
δ Orionis ...	5·73	Bo	0·60
α Virginis	4·01	B2	0·82
α Coronæ ...	17·36	Ao	0·06

Constant Stars.

Star	Period *d*	Spectrum	$\frac{m^3_2 \sin^3 i}{(m_1+m_2)^2}$
α Andromedæ ...	96·67	Ao	0·18
α Aurigæ ...	102·02	Go	0·18
ι Orionis ...	29·14	Oe5	1·14
α_1 Geminorum ...	2·93	Ao	0·0097
α_2 Geminorum ...	9·22	Ao	0·0015
ζ Ursæ Majoris...	20·54	Ap	0·49
β Scorpii ...	6·83	B1	1·26

LATITUDE VARIATION 1913·0 TO 1914·0.—Prof. Albrecht communicates to the *Astronomische Nachrichten*, No. 4749, provisional results of the International Latitude Service for the period 1913·0 to 1914·0. The information is presented in a form similar to those previously published, and so is familiar to readers of this column. Since 1912 the amplitude of variation has become rapidly reduced. A useful diagram accompanies the communication displaying graphically the track of the pole from 1909·0 to the beginning of the present year.

A CLOSE COMPANION TO η ARGUS.—Mr. R. T. A. Innes publishes in the *Monthly Notices* for June (vol. lxxiv., No. 8, p. 697) some details about the magnitude of η Argus and the discovery of a close companion. The former observations were made as it was reported that this star had become a naked eye object in 1913, but it is shown here that since 1899 the magnitude (7·7 about) has not changed, no variation greater than the errors of estimation being detected. On June 10 Mr. Innes found that η Argus was not a single star, but had a faint companion north following (74°, 1″, mags. about 8·0 and 10·5). Mr. Innes recalls an observation of his made in 1900, when he found the star single, and he refers to Prof. See's unsuccessful search in 1897 for duplicity. Thus he concludes that there is a fair *a priori* probability that the companion is in orbital movement, and suggests that the outbursts of light which have occurred in the past have been caused by periastral grazings. Two other observers corroborated the presence of this companion, and it was further noticed at the same time that η Argus appeared fuzzy, it being impossible to focus this star sharply while neighbouring stars of much the same hue, as well as those both redder and yellower, could be sharply focussed.

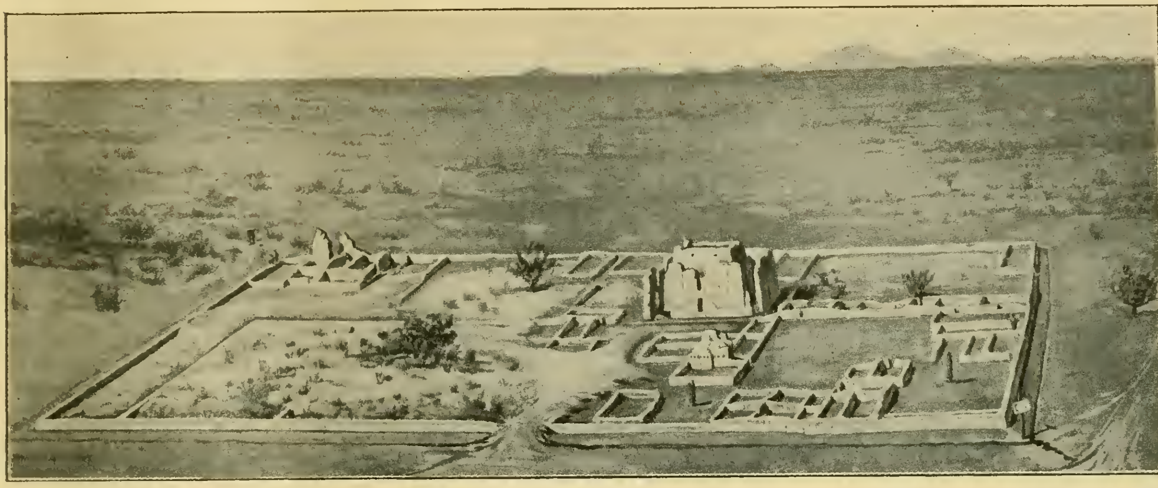
RELICS OF A LOST CULTURE IN ARIZONA.

DR. J. WALTER FEWKES gives a detailed and fully-illustrated account of his archæological investigations of the Casa Grande, and in the Upper Verde River and Walnut Creek valleys, Arizona, in the Twenty-eighth Annual Report of the Bureau of American Ethnology, 1906–7 (1912). Immediately after the discovery of Casa Grande by Father Kino in 1694, there arose a legend, which became persistent, that it was one of the halting-places of the Aztec on their way south. There is, however, no evidence to connect the inhabitants of this building with any of the tribes of the Mexican plateau.

The ruins consist of four compounds and several "clan houses." The compounds are surrounded by a rectangular wall and contain numerous buildings; in one there is a large castle-like building, the Casa Grande. The builders evolved two distinct types of architecture: (1) "great houses," with thick walls, apparently constructed by many persons—features which point to these structures as devoted to public purposes; (2) one-room habitations with wattle walls, provided with a central fire-place in the floor, and with a doorway in the middle of one of the long sides. The presence of stone idols (of which many are figured) indicates a well-developed ceremonial system. While the inhabitants possessed effective weapons in the form of spears and bows and arrows, they were essentially agricultural, cultivating fields of maize, and possibly beans, squashes, and the like. They also gathered mesquite beans. They wove various fibres into coloured belts and cloth, and raised cotton. They made basketry and unglazed pottery, which they decorated with symbols. In disposing of their dead they practised both cremation and inhumation.

Dr. Fewkes concludes that the whole drainage system of the Gila river was inhabited by an agricultural people in a homogeneous stage of culture. Throughout this region existed minor divisions of a common stock. The Pima name Hohokam, or Ancients, may be adopted to designate this ancestral stock, to whom may be ascribed the erection of the *casas grandes* on the Gila. These "great houses" were places of refuge, ceremony, and trade. They were inhabited by, and ruled by, chiefs, whose names are known to the present Pima. The people lived in small huts of perishable character, not unlike the Pima *jacales* of historic times. In the course of time a hostile faction bent on pillage came into this region from the east and west and drove the agriculturists out of their *casas grandes*, or, at least, broke up the custom of building such structures. But, although dispersed, the ancient house builders were not exterminated; some of them became refugees and migrated south into Mexico, some followed the course of the Verde and the Tonto into the northern mountains; but others, perhaps the majority, gradually lost their former culture, and remained in the Gila valley, becoming the ancestors of the present Pima, Papago, and Kwahadt (Quahatika). Those who went northward later built pueblos, now in ruins, in the Little Colorado valley. Their descendants ultimately joined the Zuñi and the Hopi, according to their legends, with whom they still live.

Although Dr. Fewkes refers to the Hohokam as being "homogeneous," the fact that they practised two forms of burial would lead one to suppose a mixture of two cultures. He also points out that whereas the Hohokam dwellings were rectangular, those of the Pima are circular in form, but some of the Pima houses are rectangular; also the Pima do not burn their dead. Dr. Fewkes concludes by saying: "In considering the prehistoric migrations of agricultural peoples in the south-west, especially with respect to changes in culture and to diminution of population, we must not lose sight of the influence of increased salinity due, directly or indirectly, to long-continued prehistoric irrigation. This cause was perhaps more effectual than human enemies or increased aridity [as Ellsworth Huntingdon claims] in breaking up the prehistoric culture. If barrenness of the soil, due to the cause mentioned, led to the abandonment of populous aboriginal compounds, this fact has an important bearing on the future of the white farmers in the Gila and Salt River valleys." A. C. HADDON.



Bird's-eye view of Compound A, from the east.

THE PRINCIPAL TRIANGULATION OF THE UNITED KINGDOM.[1]

THIS publication of the Ordnance Survey deals with a subject of especial interest, since it sets forth the operations which were undertaken in 1910, 1911, and 1912, in order to test the accuracy of a portion of the principal triangulation of the United Kingdom, and discusses the results obtained. This triangulation, which was observed during the seventy-two years, 1783–1853, comprises 552 triangles, and the mean error of an angle as given by Ferrero's formula, $M=\sqrt{\frac{\Sigma\Delta^2}{3n}}$ is $\pm 1{\cdot}8''$, a value which is somewhat larger than that of recent first order triangulation. This raised the question whether the triangulation was suitable for incorporation with recent Continental geodetic work. It was therefore decided to measure a new base in a part remote from the principal bases of the triangulation at Lough Foyle and on Salisbury Plain, and to re-observe a portion of the principal triangulation in its neighbourhood.

[1] Ordnance Survey. Professional Papers, new series, 2. "An Investigation into the Accuracy of the Principal Triangulation of the United Kingdom." By Capt. H. St. J. L. Winterbotham. With an Introduction by Col. C. F. Close. Pp. 20+v plates. (London: H M. Stationery Office; Wyman and Sons, Ltd., 1913.) Price 2s.

This new base was measured near the town of Lossiemouth, on the southern shore of Moray Firth, and the operations have been described in Professional Paper, No. 1, 1912, where the probable error of the final value is given as 1 in 900,000. The original triangulation was computed in terms of the 10-ft. standard bar of the Ordnance Survey, and a useful chapter of this paper places on record the relations between this bar, the French legal metre, and the international metre of the Bureau International des Poids et Mesures. The three stations—Corriehabbie, Mormon Hill, and Knock of Grange—in the principal triangulation were selected near the Lossiemouth base for the work of verification; but some difficulty was experienced on account of the observation points not having been marked originally in as permanent a manner as is now employed, wooden pickets having been used. All triangulation points that are now being occupied and those of the test triangulation are marked with bronze bolts set in rock or in a thick foundation of concrete.

The angles were measured with a 12-in. theodolite constructed for this work by Messrs. Watts and Sons, the horizontal circle being read by means of three microscopes. Eight arcs were observed, and the mean error of an angle in the twenty-nine triangles is given as $\pm 0{\cdot}517''$.

For marking the points to be observed both lamps and heliostats were provided, the pattern being the same as that used in the measurement of the arc of meridian in Uganda; but it was rarely possible to use the heliostats even during the exceptionally fine summer of 1911, and practically all the observations were made on lamps. The theodolite is briefly but not exhaustively described, and a detailed investigation of it would be of much interest. The readings of the horizontal circle are to single seconds, and to tenths of a second by estimation; the vertical circle is only 6 in. in diameter, and is read to one minute of arc, being merely intended for setting to any known angle of elevation.

A special plumbing telescope, which is screwed into the upper horizontal plate, and can be focussed to view marks at from 3–20 ft. distant, provides the means for accurately centring the instrument over the station mark. Concrete observing pillars were used at each station, and were made with a central vertical shaft over the station mark, this being illuminated through horizontal view-holes provided in the base of the pillar.

A large triangulation error which was found in the base extension is discussed, and the conclusion is reached that it was probably due to lateral refraction caused by a cairn near to which the doubtful ray passed.

The alterations which this check triangulation would produce in the sides which were revised were from 1 in 39,000 to 1 in 94,000, and the angular corrections from 0·989″ to 1·066″.

Captain H. Winterbotham proceeds to discuss the accord between the bases which have been measured at Salisbury Plain, Lough Foyle, Lossiemouth, and the French base at Paris, calculated through the side Cassel les Harlettes, and investigates the accuracy of the triangulation as shown thereby. Four other bases which were measured with Ramsden's steel chains at the beginning of the eighteenth century are also compared, though they were not used in the reduction of the triangulation, and are in good agreement with the other results.

The general result is to show that the alteration which would probably be caused by the re-measurement of an arc in the United Kingdom would be small, and that the agreement between the calculated and computed lengths of the Salisbury Plain and Lough Foyle bases was not accidental, since the other bases here used indicate an accuracy of triangulation of the same order.

H. G. L.

THE BONAPARTE FUND.

THE Committee appointed by the Paris Academy of Sciences to allocate the amount placed at its disposal by Prince Bonaparte, makes the following proposals for grants during 1914.

2000 francs to Dr. Pierre Breteau, for the continuation of his researches on the use of palladium in analysis and organic chemistry; 2000 francs to M. Chatton, to enable him to continue his researches on the parasite Peridinians; 3000 francs to Dr. Fr. Croze, for the purchase of a concave diffraction grating and a 16 cm. objective, to be used in work on the Zeeman phenomena in line and band spectra; 6000 francs to Dr. Hemsalech, for the purchase of a resonance transformer and battery of condensers, to be used in his spectroscopical researches; 2000 francs to P. Laïs, for assisting the publication of the photographic star map; 2000 francs to M. Pellegrin, to assist him in pursuing his researches and continuing his publications concerning African fishes; 2000 francs to Dr. Trousset, to assist him in his studies of the minor planets; 2000 francs to M. Vigouroux, to enable him to continue his researches on silicon and its different varieties; 3000 francs to M. Alluaud, to assist the publication (with Dr. R. Jeannel) of the scientific results of three expeditions to eastern and central Africa; 9000 francs divided equally between MM. Pitart, de Gironcourt, and Lecointre, members of the Morocco expedition, for scientific study, organised by the Société de Géographie; 2000 francs to M. Vasseur, for the continuation of his geological excavations in a fossil bearing stratum in Lot-et-Garonne; 3500 francs to Dr. Mauguin, for the continuation of his work on liquid crystals and the remarkable phenomena presented by these bodies when placed in a magnetic field; 2000 francs to Dr. Anthony, to defray the cost of his researches on the determinism of morphological characters and the action of primary factors during evolution; 4000 francs to M. Andoyer, to assist the publication of his new set of trigonometrical tables; 4000 francs to M. Bénard, to enable him to continue, on a larger scale, his researches on experimental hydrodynamics; 2000 francs to Dr. Chauvenet, for the continuation of his researches on zirconium and the complex combinations of that element; 2000 francs to François Franck, for the chronographic study of the development of the embryo, with special examination of the rhythmic function of the heart; 2000 francs to M. Sauvageau, for the pursuit of his studies on the marine algæ.

The Committee recommends these eighteen grants after considering close upon sixty applications for assistance. The amount allocated for the year is 54,500 francs.

NAPIER TERCENTENARY CELEBRATION.

THE Tercentenary Celebration of the publication of Napier's Description of the Wonderful Canon of Logarithms opened formally on July 24 under the auspices of the Royal Society of Edinburgh. On Thursday at two o'clock, however, the Committee was able to open to the members of the congress the exhibition of books, calculating machines, mathematical models, relics of Napier, portraits, and other objects of mathematical interest. A fair number of visitors had already arrived in the city, and on the Friday morning the examination room of the University, in which the exhibition was arranged, was a lively scene. The tide-predicting machine under the charge of Mr. Edward Roberts attracted a large amount of attention. Many forms of arithmometers and calculating machines, from the abacus of the East and Napier's "Bones" down to the beautiful instruments of the present day occupied a large part of the hall. Each member received, along with his membership card, the handbook of the exhibition, a large octavo of 340 pages, which contained, not only a descriptive catalogue of what was on exhibition, but also sustained scientific articles on sun-dials, slide rules, integraphs, planimeters, harmonic analysers, nomograms, mathematical models, etc., etc. The articles were contributed mainly by members of the mathematical departments of the Universities of Edinburgh and Glasgow, under the editorship of E. M. Horsburgh.

The opening meeting of the congress was held in the debating hall of the University (Students') Union. The Lord Provost of Edinburgh occupied the chair and introduced Lord Moulton in a brief speech, recalling the main facts of Lord Moulton's mathematical career. Among the audience which filled the fine hall may be mentioned Prof. Andoyer, Prof. Bauschinger, Prof. Cajori, Sir William Bilsland, Dr. Dugald Clerk, Prof. Conway, Dr. Glaisher, Dr. J. P. Gram, Prof. Hill, Prof. Hobson, Prof. Macdonald, Major MacMahon, Dr. Conrad Müller, Sir Alexander Napier, Prof. Nielsen, Prof. d'Ocagne, Prof. Putnam, Berkeley, Cal., Dr. Sheppard, Prof. Stekloff, limiting the list to a few of the representative men from a distance.

Lord Moulton, in his inaugural address, endeavoured to trace the origin and growth of the ideas which finally took form in Napier's *Descriptio*. Emphasis was laid upon the fact that Napier's first table is a table of logarithms of *sines*. This seemed to indicate that Napier's intention was to facilitate trigonometrical calculation, although in the *Descriptio* itself this limitation soon disappears from view. Lord Moulton divided what he judged to be the course of discovery into three stages. The first stage was to create tables which would enable numbers to be multiplied together without actually performing the calculation. For this purpose they must proceed in an order resulting from continued multiplication. The word logarithm seems to preserve the trace of this stage, for there can be little doubt that the word means "the number of the ratio." The second stage consisted in passing from the idea of figures to the geometrical representation of the quantity by a line, the repeated operations being perfectly represented by repeatedly cutting off the same fraction of the diminished length. This led Napier to establish the proposition that the logarithms of proportionals are "equally differing." Napier felt fully the importance of this proportion, and he literally revelled in it, showing how it enabled us to find mean proportionals of all kinds, extract roots, calculate powers. In the third stage he boldly applied his principle to continuous motion. Napier was now ready to calculate his table. We give Lord Moulton's own words. "He (Napier) takes the radius and forms from it a geometrical series where the reduction between successive terms is one-hundredth. Say he takes 60 terms of such a series. He knows the logarithms of all these terms and he writes them over against the number. These are widely separated by intervals commencing with 100,000 and diminishing as they proceed. He then takes each of these numbers as the first terms of a geometrical series, where the reduction is 5000 out of the million, *i.e.*, one two-thousandth. He knows the logarithms of all these numbers. . . . Thus he has 1200 numbers fairly well distributed over the field, and of these he knows the logarithms. . . . They are to serve as his measuring posts. He therefore takes the table of sines which gives the numbers of which he wished to calculate the logarithms. Taking each sine he sees where it, regarded as a number, comes in the scale. It cannot be far from a measuring post. His method enables him to make a proper allowance in its logarithm for this small difference in fact, and as the logarithm of the measuring post is known the logarithm of the sine is known also. . . . I have now given you, as I read it, the line of discovery which led up to Napier's table of logarithms. What deeply impresses me is his tenacity of aim combined with his receptivity of new ideas for attaining it. From first to last it was a table of logarithms of sines that he proposed to make and he did not permit himself to be turned aside from that purpose till it was completed. His concepts evidently widened as he proceeded. . . . As soon as the discovery had actually seen the light . . . . Napier proceeded justifiably to destroy the scaffolding which had been so serviceable in the erection of the building. For example, the plan of taking the radius as the starting point had been of inestimable service in keeping up the continuity of his methods. Before his tables were published he had seen that this was unnecessary and he proclaimed it to be so in the *Descriptio*. We know that at this time he had seen that it would be better to start from unity as the number the logarithm of which should be zero. . . . A still more remarkable change which he himself proposed was to follow up the last proposal by fixing unity as the logarithm of 10. That this could be safely done could scarcely have been seen by him until the completion of his work. From the top of the mountain he could see how the climb might be made easier by deviations which to the climbers might well seem to be courting unnecessary difficulty. . . . Napier took twenty years to do the work—many of which, probably the greater part of which, were spent in arriving at his method. It would be sad to think that most of this was wasted because the solution came by a lucky chance at the last. In my view all these years did their share, and I have tried to show how gradual and continuous was his progress. As to the greatness of the achievement it is needless to speak. Logarithms have played well nigh as important a part in mathematical theory as in practical work. We know infinitely more of their nature than Napier or any man of Napier's age could have done. We have means of calculating them so effective that if all the logarithmic tables in the world were destroyed the replacing them would be the work of a few months. But not all the three centuries that have elapsed have added one iota to the completeness or the scope of the two and only existing systems of logarithms as they were left by the genius of John Napier of Merchiston."

On the Saturday forenoon the members met in one of the class-rooms of the University to discuss chiefly historic questions relating to the discovery of logarithms. Prof. Hobson was voted to the chair, and Dr. Glaisher opened the discussion by an interesting paper on certain aspects of Napier's work. He pointed out how difficult it is for us with our convenient notations and modern notions, to realise what a supreme intellectual effort it must have been for Napier to do what he did. The problem solved by him would be expressed now-a-days in terms of a simple differential equation. The interesting view which Lord Moulton had brought forward the previous day was worth our consideration, although he himself had never thought of getting behind the beautiful geometrical approach given in the *Descriptio*.

Prof. Eugene Smith, of New York, read a paper on the law of exponents in the works of the sixteenth century; Prof. Cajori discussed algebra in Napier's day and the alleged prior inventions of logarithms; Lieut. Salih Mourad, of the Turkish navy, gave a short account of the introduction of logarithms into Turkey; and in a brief note from Dr. Vacca, of Rome, it was pointed out that a compound interest rule given in an Italian work of the fifteenth century virtually contained the approximate calculation of the Napierian logarithm of the number 2. Prof. Gibson communicated a careful discussion on the question of Napier's logarithms and the change to Briggs's logarithms. These historic papers raised a good deal of discussion, in which the authors already named, the chairman, and Dr. Conrad Müller took part. Dr. Glaisher agreed very emphatically with Prof. Cajori that it was dangerous to take information second hand. An error carelessly made by one historian was copied by others, and once the error got started it was difficult to get rid of it. It was not always easy to reach first sources. He had, for example, never seen a copy of Bürgi's antilogarithmic table (as it would be called now) until the day before, in the exhibition, when, through the kindness of the Town Librarian of Dantzig, a copy had been placed on view. The other side of Napier's mathematical work was represented by a paper by Dr. Sommerville on Napier's rules and trigonometrically equivalent polygons, with extensions to non-euclidean space.

On the Friday night the Lord Provost of Edinburgh and the Town Council gave a brilliant reception in the new Usher Hall. On Saturday afternoon the members were received at a garden party by the governors and headmaster of Merchiston Castle School, and were shown the small room at the top of the battlemented tower where Napier used to think and work. On Saturday evening the members and their friends met for social enjoyment in the hall of the University Union.

A memorial service was held in St. Giles's Cathedral on the Sunday at 3.30 p.m. The officiating clergyman was the Rev. Dr. Fisher, of St. Cuthbert's Parish Church, of which church John Napier had been an elder, and in the graveyard of which his body lies buried. A special feature of the service was the presence of the masters and boys of Merchiston Castle School. They numbered 260, and filled the transept of the Cathedral

C. G. KNOTT.

THE STARS AROUND THE NORTH POLE.[1]

A KNOWLEDGE of distances of the stars is of fundamental importance in any attempt to describe the stellar universe It is required, before answers can be given to questions on the average distances of stars from one another, their brightness compared with the sun, and the extent to which they reach in space. There are not more than 100 or 150 stars of which the distances have been measured with any degree of accuracy. Although this number is being steadily increased, it is only the stars which are comparatively near to the sun which can be treated individually. For the greater number we have to be content with average values which apply to groups of stars.

A map or a photograph of the stars gives only their bearings—that is to say, their directions as seen from the earth. It gives no information whatever about the distances. One star may be a hundred times as far away as its neighbour on the map. But if two maps are made, separated by a sufficient interval of time, some differences will be found in the relative positions of the stars. These indicate movements either of the stars themselves or of the point from which they are viewed. But the movements which are observed are merely changes of angular position. We cannot tell directly from them either the actual velocities or distances of the stars, but only the ratio between these quantities. It is, however, from the geometrical study of these small angular motions, supplemented by the information obtained from the spectroscope as to the velocities of stars in the line of sight, that our knowledge of their distances is derived.

The problem is in many ways analogous to one which has been completely solved. In the early days of astronomy the movements of the wandering stars or planets were noted. The essential characteristics of the movements were embodied in geometrical formulæ by the Greeks. In the course of time Copernicus showed that these formulæ could be most simply interpreted on the assumption that the earth revolved round the sun. His purely geometrical arguments were, it is true, powerfully reinforced by the revelations of Galileo's telescope. Nevertheless, the planetary system as formulated by Copernicus and Kepler resulted from the observation of the angular movements of the planets and the attempt to give them the simplest possible geometrical interpretation.

Further study of the planetary system has been guided and controlled by the law of gravitation. But the observational data on which our very complete knowledge of the solar system is based, the distances, sizes, and movements of all its members, are a long series of measures of the angular movements as seen from the earth. Linear measurements are only required to obtain the form and dimensions of the earth itself, and thus supply a base line to determine the scale of the system.

The fixed stars present us with a very similar problem. From the study of their small angular movements, supplemented by spectroscopic observations, it is required to construct as far as possible a model of the stellar universe. Such a model would give for each star :—

(i) Its actual position in space, measured along three axes with the sun as origin.

(ii) The velocity in kilometres a second in each of these directions.

(iii) The brightness or luminosity, taking the sun as unit.

(iv) The mass.

(v) The size.

(vi) The physical and chemical constitution.

[1] Discourse delivered at the Royal Institution on Friday, April 24, by Dr. F. W. Dyson, F.R.S.

Of these elements the mass is at present only determinable for double stars, and the size for eclipsing variables. The physical and chemical constitution are known from spectroscopic observations for a considerable number of stars. But the distance and absolute brightness can be found only for a limited number of the nearer stars. Average results can, however, be obtained for the more distant stars, which tell us :—

(1) The number within certain limits of distance from the sun.

(2) The mean velocities of these stars, and what percentage are moving with given velocities, say, for example, between 10 and 20 kilometres a second.

(3) Whether these velocities are irregular or show anything in the nature of streaming in particular directions.

(4) What proportion of the stars are comparable with the sun in intrinsic brightness, and what proportion are ten times or one-tenth as bright, and so on.

Such a description of the stellar system is, to a large extent, within the powers of astronomers, and we nurse the perhaps extravagant hope that generalisations will be discovered which will lead to the formulation of dynamical laws on the constitution of the stellar universe.

A small area round the pole has been chosen as a sample, because this part of the sky has been observed more fully than any other of equal extent. It forms a small cap extending to a distance of 9° from the pole, and covering about 1/160 of the whole sky. In the years 1855–6 Carrington, an English amateur astronomer, well known from his observations of sun-spots, using a very small transit instrument, observed the positions of all the stars in this part of the sky from the brightest down to very faint stars between the 10th and 11th magnitudes. He thus constructed a catalogue, giving with great accuracy the positions of 3700 stars for the year 1855. About the year 1900 these stars were re-observed at Greenwich by a combination of visual and photographic observations. By comparison with the positions as given in Carrington's Catalogue, the angular movement of each of these 3700 stars in forty-five years is determined. These angular movements, or "proper motions" as they are technically called, are the data available for obtaining the actual positions and movements of the stars in space. We have to solve the geometrical problem of making these stars stand out in three dimensions, so that we may see them as we see a picture in a stereoscope.

Now the proper motions of stars are very small. The star of largest proper motion moves only 870″ a century. An idea of the smallness of this motion may be obtained from the fact that it will take two centuries to move a distance equal to the apparent diameter of the sun or moon. There is no star among those near the North Pole with a proper motion so great as this. The following table gives an abstract of the proper motions of the 3726 stars under consideration :—

Table I.

Limits of Proper Motion.		Number of Stars.
>40″ a century	...	2
20″—40″ „ „	...	39
10″—20″ „ „	...	134
5″—10″ „ „	...	574
3″— 5″ „ „	...	977
0″— 3″ „ „	...	2,000

It is clear that the stars with large proper motions must either be moving fast or must be comparatively near. These are the alternatives, but for an individual star it is impossible to decide between them.

The table shows how largely the proper motions of stars vary in amount. They differ just as widely in direction. Some signs of irregularity in the directions were first detected by Sir William Herschel, who found that the movement of seven quick-moving stars situated in different parts of the sky were approximately directed to one point. He observed that this would result if the proper motions arose not from the movement of the stars themselves but from that of the point of observation in an opposite direction, and concluded that the solar system was moving towards a point in the constellation Hercules. This conclusion was not universally admitted for some time, but researches by Argelander, Airy, Bessel, and others demonstrated a regular drift among the stars, such as would arise if on their otherwise irregular movements were superposed this common motion. A large number of researches have been made on the exact direction of the sun's motion, and it is now established with some certainty that it is towards a point in right ascension 18h. and declination 35° N., not far in direction from the bright star Vega. The speed of the sun's motion through space has been determined by spectroscopic observations. On the average, stars near Vega appear to be approaching us, stars in the opposite direction to be receding from us. In this way Prof. Campbell has found from the observed velocities of 1500 stars that the solar system is moving at the rate of 19·5 km. a second.

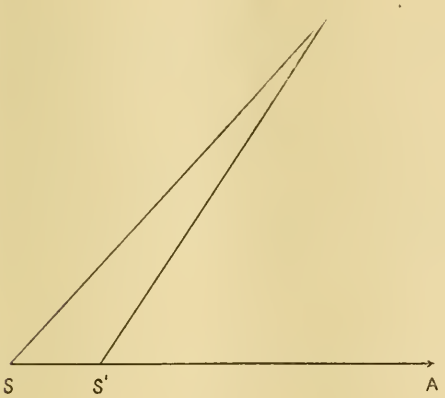


FIG. 1.

The fact that the sun is moving with a velocity of 19·5 km. a second in a known direction supplies us with a means of determining the average distances of groups of stars. This velocity carries the sun forward in a century a distance equal to 412 times the sun's distance from the earth. If at the beginning of the century the sun is at S, and at the end has moved to S′, the angular distance of a star situated at P, and having no motion of its own, will have increased from ASP to AS′P. The difference of these angles, which is the proper motion of the star, is SPS′, and it follows that the distance (SP) can readily be deduced. We cannot, however, say that any individual star is at rest, but if we take a sufficiently large group of stars it is legitimate to suppose that in the average the peculiar movements of the separate stars are eliminated, and the mean distance of the group can be inferred.

During the last twenty or thirty years the proper motions of many stars have been determined by the comparison of modern with earlier observations. Particularly the reduction by Dr. Auwers of Bradley's observations made in 1755 led to the accurate determination of the angular movements of the brighter stars. The proper motions of fainter stars have been found by comparison with observations made in the first half of the nineteenth century. These have all been utilised to determine the direction and angular amount of the drift produced in the stars by the motion of the solar system through space. The results were very puzzling, because different mathematical methods and different groups of stars gave widely different directions for the solar motion. The cause was discovered about ten years ago by Prof. Kapteyn, who found in the proper motions of the stars another indication of regularity, or perhaps it might be called a systematic irregularity smaller than the one discovered by Herschel, but unmistakable when once pointed out. He interpreted these systematic irregularities to mean that the stars are divisible into two groups streaming through one another in opposite directions in space. Prof. Kapteyn's discovery has been submitted to mathematical analysis by Prof. Eddington and Prof. Schwarzschild. Their researches have illuminated the whole subject of stellar motions; and though they are not in entire agreement, they leave no doubt of the existence of a preferential movement among the stars towards the north part of Orion and the diametrically opposite direction in the constellation of the Serpent.

We must next consider the *motus peculiares*—the irregular movements of the stars themselves. From observations of the velocities of stars in the line of sight, especially from those made at the Lick Observatory under Prof. Campbell's direction, it is known that a few stars are moving with great velocities, such as 100 km. a second, while others are moving very slowly. The following analysis of Campbell's results for one class of stars—those of spectral type A—(taken from a paper by Prof. Eddington) shows the proportion of slow-moving, moderate, and quick-moving stars:—

TABLE II.

Velocities		Number of stars observed		Number of stars given by error law
0—5 kil/sec	...	55	...	53·4
5—10	...	47	...	46·2
10—16	...	30	...	38·3
16—25	...	30	...	27·4
25—40	...	10	...	6·7
>40	...	0	...	0

Comparison with the third column of the table shows that the velocities are distributed in accordance with the law of errors. The law is identical with that found by Maxwell for the velocities of the molecules of a gas. In the case of a gas, this distribution of velocities results from the frequent collisions. For the stars there is no evidence that it has resulted from their interaction. It must be regarded as an observational fact which permits us to say that the distribution of the velocities of the stars is stated concisely by this simple mathematical formula.

The three movements—the movement of the solar system in space, the streaming of the stars—and their irregular movements are all shown in their proper motions. The figure (taken from a paper by Mr. Jones—Monthly Notices of the R.A.S., vol. lxxiv., p. 196) exhibits the proper motions of some of the brighter stars situated near the North Pole. If the stars had all been placed at the origin they would in a century have spread out as shown in the figure.

This spreading out has been caused by:—

(i) The solar motion, which has shifted the centre of gravity of the swarm towards 180°.

(ii) The peculiar motions of the stars themselves, which have spread them out in the directions towards 90° and 270°.

(iii) The streaming in the direction 0° to 180°, which, combined with the peculiar motions, has made the spreading out much greater in this than in the perpendicular direction. In this part of the sky the streaming happens to be in the direction of and opposite to the solar motion.

Let us now consider the proper motions of the 3700 stars observed by Carrington in the light of these discoveries. The shift of the centre of gravity caused by the solar motion is 1·44″ a century. As we know how far the sun has moved in a century, this gives the average distance of these stars as fifty million times the distance of the sun from the earth. Turning now to the proper motions in a direction perpendicular to that of the sun's motion, which arise from the *motus peculiares* of the stars themselves. Counting these cross proper motions, we find them divided as shown in Table III.

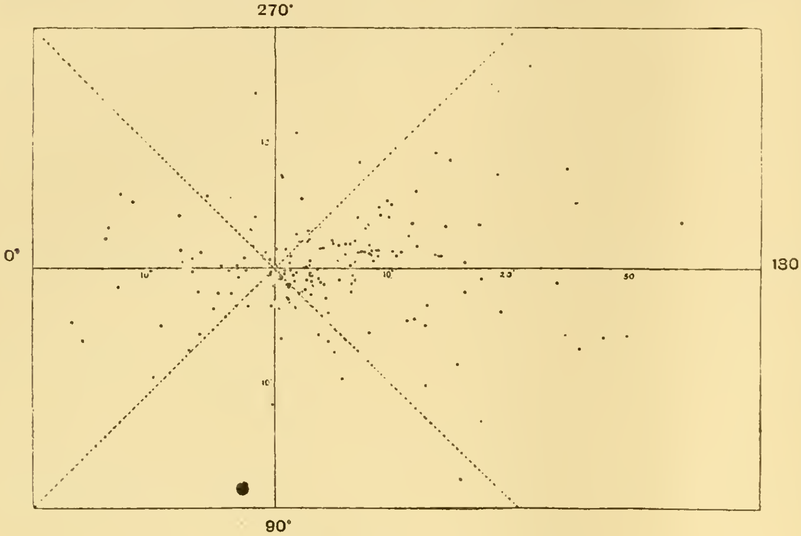


FIG. 2.—Proper Motions of Group A5–F9.

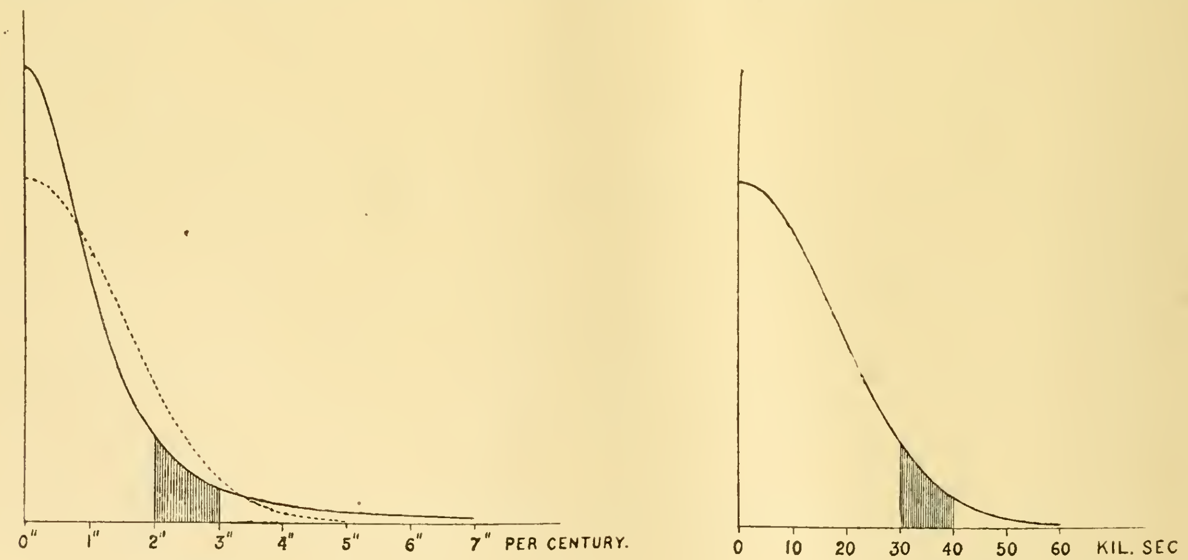
When suitable allowance is made for the accidental error in these observations, it is found that the number less than any given amount τ can be represented by the following algebraical formula:—

$$3700\frac{\tau}{\sqrt{(\tau^2 + 1\cdot47^2)}}.$$

The distribution of the angular velocities is shown in Fig. 3 (A), the total number being represented by the area of the curve; the number, for example, between 2″ and 3″ a century is given by the shaded portion.

Now suppose that all these stars were actually moving with the same velocity, say 10 km. a second, then their distance could be calculated, those with proper motion 1″ a century being forty million times as distant as the sun, those with proper motion 2″ a century twenty million times, those of 4″ a century ten million times, and so on, the larger the proper motion the nearer the star to us.

This is only an illustration; the velocities of the stars are not all the same, but are distributed according to the law of errors. If the distance of each star were known, then by dividing the velocity by the distance the proper motion would be found. We have to find how many are at one distance, how many at another, so that the proper motions will be distributed in accordance with the law found from the observations.



A.—Distribution of angular velocities. FIG. 3. B.—Distribution of linear velocities.

TABLE III.

16	are greater than	15·0″ a century				
25	lie between	10·0″	and	15·0″	a century	
33	,,	,,	8·0	,,	10·0	,,
66	,,	,,	6·0	,,	8·0	,,
191	,,	,,	4·0	,,	6·0	,,
873	,,	,,	2·0	,,	4·0	,,
2504	,,	,,	0·0	,,	2·0	,,

Fig. 3 (B) shows the distribution of linear velocities, the shaded portion, for example, giving the proportion moving between 30 and 40 km. a second. Now the distribution of angular velocities is shown in (A), and the question arises: How must the stars be distributed in distance for these two laws to harmonise?

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following awards for post-graduate research have been made at Emmanuel College:—A studentship of 150*l.* to J. Morrison for continuation of research on the igneous rocks of the English Lake district; a grant of 25*l.* to G. Williams for study in animal nutrition; and a grant of 50*l.* to W. D. Womersley for investigation of the specific heat of gases at high temperatures.

LONDON (UNIVERSITY COLLEGE).—Dr. T. B. Johnston, lecturer on anatomy in the University of Edinburgh, has been appointed lecturer and demonstrator of anatomy in the faculty of medical sciences, and Mr. G. N. Watson, fellow of Trinity College, Cambridge, has been appointed a member of the staff of the department of pure mathematics for the session 1914–15, in succession to Dr. A. N. Whitehead, who has resigned.

DR. D. STARR JORDAN, Chancellor of Leland Stanford University, has been elected president of the National Education Association.

THE biennial Huxley lecture will be delivered by Sir Ronald Ross, K.C.B., F.R.S., at the Charing Cross Hospital Medical School on October 1.

THE University Court of Edinburgh University has received and approved a proposal from the honorary secretaries of the Royal Victoria Hospital for Consumption for the foundation of a chair of tuberculosis.

MR. A. J. MARGETSON, at present assistant professor at the City and Guilds (Engineering) College, Kensington, has been appointed to the professorship of civil and mechanical engineering at the Technical College, Finsbury, in the place of Prof. E. G. Coker.

THE sum of 400,000 dollars has recently been given to the Yale Medical School of Yale University for the foundation of a fund to be known as the "Anna M. R. Lauder Fund," in memory of the late Mrs. George Lauder. The donors stipulate that a memorial professorship in public health be established for the benefit of the state of Connecticut.

THE report for 1914 of the Council to the members of the City and Guilds of London Institute has now been published. It deals fully with the work of the City and Guilds (Engineering) College, the City and Guilds Technical College, Finsbury, the South London Technical Art School, the Department of Technology, and the Leather Trades' School. During the past session 4859 classes in technological subjects were registered by the Department of Technology in 315 towns. These classes were attended by 54,510 students, showing an increase of 511 on last year's numbers. The examinations were held in 74 technological subjects, for which 21,878 candidates entered from centres in the United Kingdom alone. Including the candidates from India, and the Overseas Dominions and the candidates for special examinations and for teachers' certificates in manual training and domestic subjects, the total number examined was 25,339. Examinations were held this year in the following parts of the Empire outside the United Kingdom:—India, New Zealand, South Africa, Jamaica, Malta, and Singapore. The number of Indian candidates continues to increase and this year reached the total of 343; the number of candidates from New Zealand was 327. During the past session 232 new names have been added to the Institute's register of teachers in technology; 91 centres were visited by the Institute's inspectors; and in numerous other ways the department has been extending its activities. There can be no doubt, says the report, that the teaching of technology has greatly improved during the past few years; but it is noted that the examiners have still to direct attention to the insufficient knowledge that some candidates possess of the principles of their subjects, and to the lack of practical knowledge shown by others, and they cannot escape from the conclusion that the unsatisfactory answers in certain groups of papers indicate faulty teaching as the source.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, June 23.—Prof. William Brown in the chair.—Prof. H. J. **Seymour**: Preliminary notes on the bathymetric survey of some Wicklow lakes. Those dealt with were the two lakes at Glendalough, and the larger of the two loughs Bray. The latter, which is a typical moraine-dammed corrie lake, is at an elevation of about 1200 ft. above sea-level and has a maximum depth of about 150 ft. A noteworthy feature is the occurrence in one part of the lake of a steep cliff, about 54 ft. high, the upper edge being 90 ft. below the surface of the water. The shape suggests that it is composed of rock and not of moraine. The large lake at Glendalough, about one mile long and a quarter of a mile broad is shallower and more uniformly contoured than the above. The deepest sounding obtained was approximately 100 ft. There is fairly satisfactory evidence that the trough in which the lake lies is "overdeepened."—Prof. J. **Joly**: Experiments on the presence of thorium in cancers, etc.—R. J. **Moss**: (1) The preparation of radium emanation for therapeutic purposes. (2) The reduction of radium sulphate.

CAPE TOWN.

Royal Society of South Africa, June 17.—Dr. L. Péringuey, president, in the chair.—Dr. W. A. **Jolly**: The electrical discharge of narcine. Curves of the electrical discharge of a fish of the Torpedo family (species not yet determined) were exhibited. The curves were photographically recorded by the string galvanometer. The direction of the current through the fish is from the ventral to the dorsal surface. The deflections which make up the shock occur with a rhythm of about 50 a second.—K. H. **Barnard**: Living Phreatoicus. Although in most respects an Isopod Phreatoicus has peculiar features which link it on to the Amphipods. So far the only members of this family have been found in Australia, New Zealand, and Tasmania. Last year, however, another species was discovered on Table Mountain. This is further evidence of a former land connection between the southern continents.—L. **Péringuey**: Bushman paintings from Southern Rhodesia. The tracings throw quite a different light on the technique and probably the mental evolution of the Bush people who executed them. As usual, animals abound, but they are much more skilfully delineated than those from the Cape Colony, Orange Free State, Natal, etc.; the graceful attitude and outline of some of them make those of the latter look commonplace. For instance, the spiral of the horns of the koodoo is very plainly indicated, which is not the case in any of the numerous transfers from the Cape, etc., known to the author. Then the representation of the human figure is of a much superior type, and seems to indicate a slight phase of transition with the hieratic style of Egypt.—Prof. **Roseveare**: (1) A proof by elementary methods, without complex quantities, that every algebraic function (with real coefficients) has factors of the form $x^2 - px + q$ (p, q real). (2) Malet's proof that every equation has roots, real or imaginary, equal in number to its degree.

BOOKS RECEIVED.

Publications of the United States Naval Observatory. Second series. Vol. viii. Pp. xxxvii+465. (Washington: Government Printing Bureau.)

Wookey Hole. Its Caves and Cave Dwellers. By H. E. Balch. Pp. xiv+268. (London: Oxford University Press.) 25s. net.

On the Effects of Volcanic Action in the Production of Epidemic Diseases in the Animal and in the Vegetable Creation, and in the Production of Hurricanes and Abnormal Atmospherical Vicissitudes. By Dr. H. J. Johnston-Lavis. Pp. xii+67. (London: John Bale, Sons, and Danielsson, Ltd.) 3s. net.

The Pupil's Class Book of Geography. The British Isles. By E. J. S. Lay. Pp. 118. (London: Macmillan and Co., Ltd.) 6d.

The Elements of Non-Euclidean Geometry. By Dr. D. M. Y. Sommerville. Pp. xvi+274. (London: G. Bell and Sons, Ltd.) 5s.

An Elementary Treatment of the Theory of Spinning Tops and Gyroscopic Motion. By H. Crabtree. Second edition. Pp. xv+193. (London: Longmans, Green and Co.) 7s. 6d. net.

Oxygen and Cancer: A Biological and Bio-chemical Study. By L. Cresswell. Pp. 43. (Bradford: Matthews and Brooke.) 1s. net.

Proceedings of the Royal Society of Edinburgh. Part ii. Vol. xxxiv. Session 1913–14. Pp. 113–208. (Edinburgh: R. Grant.) 6s. 4d.

Meteorological Office. The Seaman's Handbook of Meteorology. A Companion to the Barometer Manual for the Use of Seamen. Pp. vi+191. (London: H.M. Stationery Office; Wyman and Sons, Ltd.) 2s.

Supplement to the Indian Journal of Medical Research. Proceedings of the Third All-India Sanitary Conference held at Lucknow, January 19–27, 1914. Vol. i. Discussions and Resolutions. Pp. ix+367. (Calcutta: Thacker, Spink and Co.)

Die vorzeitlichen Saugetiere. By O. Abel. Pp. v+309. (Jena: G. Fischer.) 8.50 marks.

Philosophical Transactions of the Royal Society of London. Series B. Vol. ccv. On the Floral Mechanism of *Welwitschia mirabilis*, Hooker. By Dr. A. H. Church. Pp. 115–151. (London: Royal Society.)

Complex Ions in Aqueous Solutions. By Dr. A. Jaques. Pp. vi+151. (London: Longmans, Green and Co.) 4s. 6d. net.

Wild Life in the Woods and Streams. By C. A. Palmer. Pp. xv+206. (London: A. and C. Black.) 3s. 6d.

Institute of Metals. First Report to the Beilby Prize Committee of the Institute of Metals on the Solidification of Metals from the Liquid State. By Dr. C. H. Desch. Pp. 57–118. (London.)

Institution of Engineers and Shipbuilders in Scotland. Session 1913–1914. Some Causes of Injury to Steel after Manufacture. By Dr. C. H. Desch. Pp. 33. (Glasgow.)

Äkta Pärlan Eller Lifsgatan vid Dagsljus Löst Medelst Sanning of Sanning. Pp. 100. (Goteborg.)

An Introduction to the Study of Plants. By Dr. F. E. Fritsch and Dr. E. J. Salisbury. Pp. viii+397. (London: G. Bell and Sons, Ltd.) 4s. 6d. net.

Optical Rotatory Power. Reprinted from the Transactions of the Faraday Society, Vol. x., Part i. Pp. 96. (London: Faraday Society.) 7s. 6d.

Solutions of the Exercises in Godfrey and Siddons's Shorter Geometry. By E. A. Price. Pp. viii+160. (Cambridge University Press.) 4s. 6d. net.

Linear Algebras. By Prof. L. E. Dickson. Pp. viii+72. (Cambridge University Press.) 3s. net.

Geological Literature added to the Geological Society's Library during the Year ended December 31, 1912. Pp. 266. (London: Geological Society.) 2s.

A Little Book on Map Projection. By Mary Adams. Pp. viii+108. (London: G. Philip and Son, Ltd.) 2s.

Liverpool Marine Biology Committee. L.M.B.C. Memoirs on Typical British Marine Plants and Animals. XXII. Echinoderm Larvæ. By H. C. Chadwick. Pp. viii+32+ix plates. (London: Williams and Norgate.) 2s. 6d.

Meteorological Office. Hourly Values from Autographic Records: Geophysical Section, 1912. Pp. 83. (Edinburgh: H.M. Stationery Office; London: Meteorological Office.) 3s.

The Practice of Navigation and Nautical Astronomy. By Lieut. H. Raper. Twentieth edition, revised and enlarged. Pp. xxv+934+41. (London: J. D. Potter.)

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THURSDAY, AUGUST 6, 1914.

THE NEW BRITISH FLORA.

The Cambridge British Flora. By Dr. C. E. Moss. Illustrated from drawings by E. W. Hunnybun. Vol. ii., Salicaceæ to Chenopodiaceæ. Pp. 206+206 plates. (Cambridge: University Press, 1914.) Price 2*l.* 10*s.* net.

THERE can be no difference of opinion as to the need for a new, comprehensive, and authoritative British flora. Our knowledge of British plants has increased and broadened to an extent which renders the "English Botany" quite inadequate for critical work. Sir J. E. Smith's "English Botany," with the admirable illustrations by James Sowerby, goes back to the early years of last century; and the third edition, with its much inferior illustrations, is, from the point of view of the modern worker, almost equally out of date. One of the most important changes which has influenced British botany during the last half-century is the comparative study of our flora and that of other European countries. Prof. C. C. Babington was one of the first to appreciate the importance of this relation, and his manual, now in its ninth edition, is still regarded as the most critical presentation of the botany of the British Isles. It is appropriate that Babington's successor in charge of the Cambridge Herbarium, and the Cambridge University Press, should be jointly responsible for a comprehensive and up-to-date presentment of the same subject.

It goes without saying that Dr. Moss has entered upon a difficult piece of work. The treatment adopted, as illustrated by the one volume which has already appeared, shows that the work is to be no mere compilation, but that it will record the results of a thorough critical study of each group. The full meaning of this will be realised only by those who have followed the detailed study of the flora of north and central Europe, of which our own forms a part, during the past few decades. Dr. Moss has special qualifications for this work, but to bring such an undertaking to a satisfactory completion within reasonable time is more than one man's task, and we are glad to note that Dr. Moss has promise of help from various botanists who have made a speciality of certain groups. We trust that he will make use to the fullest extent possible of this expert assistance.

The plan of the book is fully explained in the introduction. The systematic arrangement of the groups is that of Engler's "Syllabus," an arrangement which is now in general use on the continent of Europe and also in America. Following the recommendations of the International "Rules of Nomenclature," Dr. Moss uses the term "family" in place of "natural order," while the "order" is a group of higher rank—an aggregate of families. Except in a few minor points, Dr. Moss follows the "Rules," to a discussion of which he devotes several pages. He does not, however, fully appreciate the advantage of rules, namely, that you follow them, but sometimes goes out of his way to assert an individuality in matters of trifling importance. Short but adequate descriptions are given of the orders, families, and genera; those of the species are generally longer, the length varying with the needs of the case; under the species the different varieties and forms are sufficiently described; subspecies are not recognised. Synonymy, references to published figures and exsiccata are quoted in so far as these are helpful to the student of British plants; and the distribution in the British Isles and also the general distribution are given. British distribution is in many cases illustrated by outline maps. In his concept of species Dr. Moss has steered a middle course between the larger view as typified by Bentham's work and the *petit espèce* of the French botanist, Jordan.

In the present volume (vol. ii.) the earlier orders of Dicotyledons are treated, comprising the catkin-bearing families, which, with Ulmaceæ, Cannabaceæ, and Urticaceæ, form the subclass Amentifloræ, Santalaceæ, Loranthaceæ, Aristolochiaceæ, and Polygonaceæ, forming the subclass Petaloideæ, and Aizoaceæ, Amarantaceæ and Chenopodiaceæ, forming a portion of the subclass Centrospermæ. As this list indicates, plants are included which, though not indigenous, are more or less definitely naturalised, such as *Mesembryanthemum edule* (Aizoaceæ), a native of the southern hemisphere, and the American *Amarantus retroflexus*. The accurate recording of the occurrence of plants of this category is of special interest with a view to their future behaviour as items of our flora. The genus Betula has been elaborated by the Rev. E. S. Marshall, and in the family Chenopodiaceæ Dr. Moss has had the assistance of Mr. A. J. Wilmott (Atriplex), Mr. C. E. Salmon (Salsola), and Dr. E. J. Salisbury (Salicornia).

The text is very clearly printed, and the contrast of type is well-selected and helpful. A little more space might with advantage have been allowed between each family, and the typographical subordination of the genus-name is somewhat disconcerting until one gets used to it; but the general effect is dignified. A good portrait of John Ray forms a fitting frontispiece.

The plates are a special feature of the work. The generous gift to the university by Mr. Hunnybun of his series of pen-and-ink drawings of British flowering plants was, we believe, the immediate cause of its inception. A characteristic is that each drawing is made from an individual plant in the fresh state—no attempt has been made to give an abstract idea of the form, variety, or species figured. The drawings have been reproduced by photography and are remarkably clear, and sometimes very delicate representations of the whole or part of the plant; the details of floral structure are, however, often too small or incomplete. The wealth of illustration may be judged from the fact that the present volume contains no fewer than 206 plates.

The work is to be completed in about ten volumes, which, so far as is practicable, will be issued annually; each volume may be had in two parts, text and plates respectively, or, at a somewhat higher price, in one part, with the plates mounted on guards and interspersed with the text. Vol. i. has been set apart for conifers and ferns, and mosses, hepatics, and charas may also be included.

A. B. R.

GEOGRAPHICAL GUIDES.

(1) *Junk's Natur-Führer. Die Riviera.* By Alban Voigt. Pp. vi+466+vi plates. (Berlin: W. Junk, 1914.) Price 7 marks.

(2) *Einführung in die Erdbeben- und Vulkankunde Süditaliens.* By August Sieberg. Pp. vi+226. (Jena: Gustav Fischer, 1914.) Price 4 marks.

(3) *Cambridge County Geographies. Merionethshire.* By A. Morris. Pp. ix+166+2 maps. *Northumberland.* By S. Rennie Haselhurst. Pp. xi+181+2 maps. (Cambridge University Press, 1913.) Price 1*s.* 6*d.* each.

(4) *The Madras Presidency. With Mysore, Coorg, and the Associated States.* By E. Thurston. Pp. xii+293. (Cambridge University Press, 1913.) Price 3*s.* net.

(1) THE first of Junk's Natur-Führer, Dalla Torre's volume devoted to Tirol, was reviewed in this journal in December, 1913 (vol. xcii., p. 471). Alban Voigt's treatment of the Riviera differs entirely from the method adopted by his predecessor. In Tirol we were given minute references to the objects of interest along roads and footpaths, so that the scientific traveller alighting at an inn might look round before dinner for rare birds or for the traces of historic earthquakes. The guide-book to the Riviera is almost entirely devoted to a comprehensive review of the plant-life of the country, and the index contains plant-names only. Due stress is laid (p. 284) on Sir Thomas Hanbury's garden at La Mortola, a hamlet between Ventimiglia and Mentone, and 135 pages are occupied with an account of the cultivated plants, though these are not native to La Mortola. The geology of the district is treated in fifteen pages, and twelve more are given to the famous prehistoric caves of Mentone. It is clear that the greater part of this "guide-book" will be quite as useful in the library as in the field, and the description of the native flora in relation to its environment makes an appeal to every modern botanist. As examples of the author's historical method, we may mention the disquisition on *Ferula nodiflora*, the source, according to Martial, of scholastic "ferules" (p. 123), and the account of the recent immigration of *Lepidium draba* (p. 211), a steppe-plant that, like the Huns, has followed the Danube and then descended into Roman territory. The appearance of this book in Junk's series may herald further surprises. Will the promised Swiss volume prove to be an authoritative work on mountain-structure?

(2) The visitor in Italy cannot fail to become interested in volcanoes, and A. Sieberg's review of the volcanic and earth-shaken areas might well be translated into several languages. The author is on the staff of the seismological institute at Strassburg. He shows clearly how the volcanic zone is connected with the folded structure of Italy as a whole, and with the fractured and sunken basin that is now flooded by the Tyrrhenian Sea. The review of the recent history of Vesuvius is exactly what the intelligent visitor requires, and the form of the mountain is shown to depend on a series of events going back to the building of Monte Somma, which is the "first phase" indicated by Johnston-Lavis. F. A. Perret's beautiful photographs are used for many of the illustrations, and those of eruptions on Etna are especially welcome. The author's own pictures are admirable, though he has, with unusual self-denial, converted some of them into diagrams. Personal observations, such as those on the polygonal soil formed by moving ash (p. 155), add to the interest throughout a very readable book. The Æolian Islands are effectively included; J. W. Judd's papers, published in the *Geological Magazine* about 1876, should be mentioned in the useful bibliography. While accepting steam as a constituent of lava-flows, the author wisely refrains from dogmatising as to the gases of paroxysmic outbursts.

(3) The Cambridge County Geographies are continued with Merionethshire and Northumberland. Their only defect is that no single author can deal equally with the geological basis, with

the topography, with the antiquities, and with the "roll of honour." Mr. Morris, for example, assigns the magnificent examples of igneous sills, lava-flows, and tuffs, that contribute so much to the scenery of Merionethshire, to the Archæan era. The great scarp of Cader Idris, appropriately figured, is ascribed to ash. The memoir of the Geological Survey on North Wales would have supplied accurate information. The wealth of historic features in the county is well illustrated; the noble roadways are properly extolled; and the charmingly printed landscapes should send many a visitor southward from the better-known district of Snowdonia.

In Northumberland Mr. Haselhurst has a still more attractive field. We turn with equal pleasure to his descriptions of Bamburgh, the superb valley of the Tyne, and the Roman Wall, "as much a road as a wall," as he well remarks. For us, Northumberland centres in Hexham, within shelter of the Wall, and the land beyond seems wild and Pictish. Others, however, will prefer Rothbury or Alnwick; and it is hard to remember that the rich lands from Coldstream to Berwick are part of the border country, equally with Cheviot and Carter Fell. Northumberland has preserved much of its ancient character; the women workers in the fields (p. 71), who are so noticeable to the stranger, may be a tradition from a time when every man was employed in arms. The smoke of Newcastle is merely a displeasing local episode in a county that includes Corstopitum and "the strength and help of Joyous Gard."

(4) The Cambridge University Press has placed a series of "Provincial Geographies of India" under the editorship of Sir T. H. Holland, which is in itself a sufficient guarantee. The mode of production and the illustrations are in every way worthy of the publishers, and make the low price seem more surprising. A feature of our age which too often passes unnoticed is that the cost of good books has steadily gone down. Such a volume as this on Madras should be in the library, not only of geographers, but of teachers of imperial history. Anthropological details are abundant, and a tale of the suspension of two dacoits in iron cages, apparently under British rule, finds its way somehow into a chapter on mountains, while the demon Biraiya figures in that on rivers. The author has the power of sustaining interest; he knows the country and the people, and we are glad to know them in his company. The quaint *Ostracion cornutus* (p. 33), the fish that was once a cow, until its grazing-ground was converted into an island, shows how legends may record actual earth-changes. Mr. Thurston has the invaluable gift of sympathy, which makes him write of "the delightful group of baby elephants" in a seventh-century bas-relief, and allows him to touch on native customs without a trace of the old-time condescension. The modesty of the editor, to whom the term charnockite is due, may account for the absence of any explanation of the special characters of this rock (p. 57).

G. A. J. C.

GENETICS.

(1) *Elemente der Exakten Erblichkeitslehre mit Grundzügen Biologischen Variationsstatistik.* By Prof. W. Johannsen. Zweite Deutsche Ausgabe in 30 Vorlesungen. Pp. xi+723. (Jena: Gustav Fischer, 1913.) Price 13 marks.

(2) *Selektionsprinzip und Probleme der Artbildung.* Ein Handbuch des Darwinismus. By Prof. Ludwig Plate. Vierte Auflage. Pp. xv+650. (Leipzig and Berlin: W. Engelmann, 1913.) Price 16 marks.

(3) *Einführung in die Vererbungswissenschaft.* By Prof. R. Goldschmidt. Zweite Auflage. Pp. xii+546. (Leipzig and Berlin: W. Engelmann, 1913.) Price 13 marks.

(4) *The Meaning of Evolution.* By Prof. S. C. Schmucker. Pp. 298. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*. 6*d*. net.

THE great interest taken at the present time in the subjects included under the comprehensive term "genetics" is illustrated by the fact that second or later editions of three standard works in German on the subject, each consisting of more than 500 pages, were published in 1913. It is inevitable that books of this kind should overlap to some extent, but they do so much less than their titles might lead one to expect. That they are so different is due partly to the great extent of the subject, which makes it possible for books to deal with different sides of it without encroaching on one another to any great extent, and partly to the wide differences of opinion which still exist, resulting in very different treatment of similar classes of facts.

(1) The first German edition of Johannsen's "Elemente der exakten Erblichkeitslehre" (1909) was reviewed in Nature of October 7, 1909, before the author's work on inheritance in "pure lines" had received the widespread recognition which has since been accorded to it. The book is now generally known to students of heredity, and our account need only describe the changes in the second edition. It has been enlarged from twenty-five to thirty lectures (from 515 to 723 pages), and as the illustrations are confined to a few diagrams, it has become a very big book. New chapters

have been added on inheritance in pure lines, and on the effects of environment, besides a large amount of new matter in the old chapters. A considerable part of the added matter refers to the more recent developments of Mendelian work; four lectures on this subject are almost entirely new, and include discussions of such matters as sex-limited inheritance and sex-determination, genetic coupling and repulsion, sterility, etc. Papers published during 1913 are referred to, but although up-to-date, the book is far more than a mere compilation, it rather presents the author's view of the subject illustrated by examples chosen from the work of many investigators. It is, of course, impossible that in so large a book, dealing with matters which are still the subject of controversy, there should not be much with which many readers will disagree. But of the book as a whole our chief criticism is that it is too long; although one could ill spare the many half-humorous touches which reveal the author's kindly personality and enthusiasm, yet 700 pages of closely printed German are more than the majority of us have time to read. As a book of reference it should be accessible to every student, but it is written to be read, rather than referred to.

(2) The third edition of Plate's "Selektionsprinzip und Probleme der Artbildung" has also been reviewed in NATURE (October 15, 1908), so that in this case also only the changes introduced in the fourth edition need be referred to. As mentioned in the preface, the chief alteration is the omission of the section on alternative inheritance, since this is dealt with in the author's "Vererbungslehre mit besonderer Berücksichtigung des Menschen" (reviewed in NATURE, May 22, 1913). This omission is counterbalanced by a great enlargement of the chapter on inheritance of acquired characters, so that the total size of the book is increased by more than 150 pages and many figures. This enlargement is due, to a considerable extent, to a full account of the experiments of Kammerer and others, which have been published since the previous edition was issued. The author's general attitude is illustrated by his statement in the preface that "de Vries has misrepresented the views of Darwin, and that his mutations are identical with Darwin's individual variations"; and "dass nur Lamarckismus und Selektionismus zusammen die Entstehung der Anpassungen und der Arten verständlich machen." The book is very valuable as a summary, but appears to us insufficiently critical in the case of some of the examples cited.

(3) Goldschmidt's "Einführung in die Vererbungs Wissenschaft" (second edition) belongs to a somewhat different category. It consists of twenty-two lectures, and is based, as the preface tells us, on the author's university course on the subject. It has the merits and defects of this kind of treatment; that is to say, its title correctly describes it as an introduction to, rather than a treatise on, genetics. It is expository rather than critical, and in places leaves an unsatisfactory sense of not getting to the bottom of the subject. It covers a wide range of subjects, is well illustrated, has a useful bibliography, and throughout contains much valuable matter. This is especially the case where it deals with the author's special branch of the subject, the inheritance of secondary sexual characters. In particular, the author's hypothesis of varying "potency" of the factors for secondary sexual characters, and of the sex-factors themselves, is perhaps the most interesting section of the book (lecture xviii.). He considers that in certain circumstances a zygote which contains factors which would normally produce one sex may develop into a hermaphrodite, or even an individual of the other sex in consequence of "Potenzverschiebung" of the sex-factors. Lack of space prevents our giving an adequate account of the hypothesis, which may have important bearing on the theory of sex-determination. In places the book conveys the impression of haste, and it would perhaps be improved if fewer examples were described, and these treated more fully.

(4) Prof. Schmucker's "Meaning of Evolution" belongs to quite a different class. It is a popular book on the general principles of the evolution theory, and makes no claim to be an original contribution to the subject. One of its objects is to show that there is no necessary inconsistency between a belief in organic evolution and religion. It is in general pleasantly written, but does not differ conspicuously from other books of the same type.

OUR BOOKSHELF.

A Descriptive Catalogue of the Marine Reptiles of the Oxford Clay. Based on the Leeds Collection in the British Museum (Natural History). Part ii. By Dr. C. W. Andrews. Pp. xxiv + 206 + xiii plates. (London: British Museum (Natural History). Longmans, Green and Co., 1913.) Price 25*s*.

THE scientific value of the remains obtained by Messrs. Leeds from the Oxford Clay near Peterborough is exemplified by the groups forming the subject of the present, and concluding, volume of this excellent and exhaustive catalogue. In order to realise this, a visit is almost essential to the Natural History Museum, where a mounted skeleton of the pliosaurian Peloneustes will come as a revelation to those unacquainted with the state of preservation of many items in the Leeds collection.

At the epoch of the Oxford Clay pliosaurs (together with their cousins the elasmosaurs) and the marine crocodiles of the families Teleosauridæ and Geosauridæ were at the zenith of their development, and therefore too advanced to afford clues to the relationships and origin of the order to which they pertain. Nevertheless, the point is not passed over by Dr. Andrews, who, after rejecting the theory of an affinity between plesiosaurs and pliosaurs on the one hand and tortoises and turtles on the other, supports the opinion that the two former are descended from the carnivorous mammal-like reptiles of the Permian and Trias. As regards Oxfordian crocodiles, the author merely affirms that while the steneosaurs (Teleosauridæ) are derived from the mystriosaurs of the Lias, the species of Metriorhynchus (Geosauridæ), on account of differences in the structure of the base of the skull, had a different origin.

As the Oxfordian crocodiles appear to have been more aquatic than any existing members of their order, while the contemporary ichthyosaurs, elasmosaurs, and pliosaurs were completely so, the Jurassic seas must have swarmed with a medley of reptilian forms of life, in striking contrast to the more uniform type presented by their cetacean supplanters of to-day. With their large heads and short necks, the Oxfordian plesiosaurs appear to have been better adapted to a pelagic existence than the contemporary elasmosaurians; and it is of interest to note that in respect of food they appear to have presented a parallelism to cetaceans, some having subsisted on cephalopods, while others attacked and devoured larger and more formidable prey. R. L.

The Future of Education. By F. C. C. Egerton. Pp. 303. (London: G. Bell and Sons, Ltd., 1914.) Price 3*s*. 6*d*. net.

This is a book provocative of serious thought in these days of educational misgiving and unrest. The author raises a strong indictment against present educational aims and methods, and adduces in support of his contentions some extraordinary incidents which have come within his immediate experience.

Especially is he wroth with our system of elementary education, and declares with emphasis:—"There is only one word that adequately describes the state of education in this country, and that is 'chaos,'" and further remarks that "as a system it is absolutely rotten from beginning to end," and that "what is said with regard to the elementary school applies with nearly equal force to the secondary school—the same narrowness of outlook, the same lack of adjustment to the requirements of life, the same unreality and artificiality characterises both types of schools."

He declares that "our organisation is entirely disjointed. Each elementary school is conducted haphazard, each secondary school is a law unto itself, and the public schools and universities go their own way, good or bad." The only comfort we receive is in the fact that "it is quite true that other countries stand in exactly the same position."

Much stress is properly laid upon the importance of the elementary school, public and private, through which ninety-five out of every hundred men and women pass. "It is the hope of the country, and it has in its power to lay the foundations of many noble lives." The writer condemns formal and disciplinary methods of education, and directs strong attention to Montessorian aims and methods, and the need for the child to be allowed fully to realise itself. In spite of some extravagance of statement, the book is well worthy of serious study. J. H. R.

Coast Sand Dunes, Sand Spits and Sand Wastes. By G. O. Case. Pp. xi+162. (London: St. Bride's Press, Ltd., 1914.) Price 5*s*. net.

The object of this book, as stated by the author in the preface, is to direct attention to the advanage of controlling the blown sand dunes on the sea-coast so as to make them act as a protection to the land behind from erosion by the sea; to prevent them from advancing inland and destroying existing vegetation, and to enable sand wastes where they exist to be reclaimed and planted with trees.

The book does not contain any, or very little, information that is not already given in the work on "The Sea Coast" published in Longman's Engineering Series, or in the report of the Royal Commission on Coast Erosion. The information on the subject dealt with is, however, given in a handy form, and will be found useful and instructive to those interested in coast geology or having charge of land bordering on the sea shore.

The subjects dealt with are: the area of land covered by sand dunes in Europe, the transportation of sand by wind action and formation of dunes, description of existing dunes in this and other countries, devastation caused by inland movement of dunes, methods for preventing dunes moving inland, protective works for face of dunes, and the reclamation of sand wastes.

Notes on the Blue-Green Algae. By Harold Wager. Pp. 48. (London: A. Brown and Sons, Ltd., 1914.) Price 2*s*. 6*d*. net.

This little book should be of considerable service to those who desire to study systematically this group of plants, which is characterised by the presence of a bluish-purple colouring matter, phycocyanin, in addition to chlorophyll, in the cells. The cell-membrane is not composed of cellulose and glycogen takes the place of starch in the protoplasm. Mr. Wager first gives a general introduction on the structure, reproduction, and classification of the group, then keys to the orders and families, a key to the genera of the Oscillatoriaceæ, and finally a key to those species of Oscillatoria and Phormidium which are fairly well determined. In the latter it would have been of service if the localities in which they have been found had been mentioned. The book concludes with a glossary and references to monographs and blank pages for notes.

LETTERS TO THE EDITOR.

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

The Hæmoproteus of the Indian Pigeon.

IN the course of a letter, which was brought by the last Indian mail, my friend, Colonel J. R. Adie, imparts the very interesting information that Mrs. Adie, working at Kasauli, has recently obtained very strong presumptive evidence that the præter-vertebrate life-history of the Hæmoproteus of the Indian pigeon agrees with that discovered by Ross for the Proteosoma of the Indian sparrow and for the malaria parasite, the intermediary in the case of the Hæmoproteus being a species of Hippoboscid fly of the genus Lynchia.

Mrs. Adie obtained from Amballa some pigeons which were heavily infected with the blood-parasite and abundantly infested with the fly. In sixteen or seventeen individuals of the fly (Lynchia), out of twenty-six examined, she found either zygotes, or cysts, or sporozoites—the last swarming in the salivary-glands, and in some cases coursing down the salivary-ducts. In one case a cyst in the wall of the gut was observed to burst and liberate hundreds of sporozoites.

Mrs. Adie's observations will be published as soon as the exact experiments which were in progress at the time Colonel Adie wrote are concluded; but her observations are in several ways so interesting that I think they ought to be made known at once.

A. ALCOCK.

Belvedere, Kent, July 28.

Radio-activity and Atomic Numbers.

MR. VAN DEN BROEK'S letter in NATURE of July 9 shows the importance of the charge upon the nucleus in radio-active phenomena. The cause of this may possibly be sought in considerations similar to the following.

If one assumes that an atom breaks up when all the nuclear charges are in a given relative position and that they are in rotation with an average frequency $\nu = E/h$, where E is their energy and h the element of action of the quantum theory, then each particle will pass through the critical position ν times per second. The probability that M particles should be in the unstable region simultaneously is $(k\nu)^{M}$, or if only relative position is involved $(k\nu)^{M-1}$, where k of course defines the size of the critical region. One would therefore expect a relation between the average life of an atom and the energy of its particles of the form

$$\lambda = (k\nu)^{M-1} = \left(\frac{k}{h} E\right)^{M-1},$$

where λ is the radio-active constant. According to Geiger the range in air is given by the formula

$$R = \frac{v^3}{1{,}24 \cdot 10^{27}} = 4{,}05 \cdot 10'' E^{\frac{3}{2}}.$$

Introducing this value one finds

$$\lambda = (2{,}77 \cdot 10^{18} k)^{\frac{2}{3}(M-1)} R^{\frac{2}{3}(M-1)}$$

or

$$\log \lambda = \tfrac{2}{3}(M-1)(\log k + 18{,}44) + \tfrac{2}{3}(M \quad 1) \log R.$$

Putting $M = 85$, which would be the average value for radio-active substance, one finds the approximate formula $\log \lambda = 56(\log k + 18, 44) + 56 \log R$. Geiger found empirically $\log \lambda = -36, 7 + 53{,}3 \log R$. According to this k would be about 10^{-19}, *i.e.* of about the order $1/\nu$. In any case the close agreement between the theoretical and observed values of the coefficients of log R would seem to show that the original hypothesis is correct in its main outlines, *i.e.* that integration occurs upon the fortuitous coincidence of n events, the probability of which is proportional to $E = h\nu$, and that n is of the order of the atomic number M. One cannot say as yet though whether the n particles, the relative positions of which determine the stability are the positive particles or the electrons.

Mr. van den Broek's formula

$$\frac{(\lambda_{Th})^2}{\lambda_{Ra}\lambda_{A}} = 4{,}5^{M-82}$$

would reduce to

$$\frac{(E_{Th})^2}{E_{Ra} \cdot E_{Ac}} = 4{,}5^{\frac{M-82}{M-1}} \quad \text{or} \quad \frac{(\nu_{Th})^2}{\nu_{Ra} \cdot \nu_{Ac}} = 4{,}5^{\frac{M-82}{M-1}}$$

The simplest interpretation of this would be that the atoms of corresponding elements of the different series are geometrically similar and differ only in their linear dimensions. A change of the attractive force with the nuclear charge is obviously probable, and Mr. van den Broek's formula will certainly be of the first importance when we attempt to determine the function representing the nuclear forces in terms of the charge and perhaps also of the distance.

F. A. LINDEMANN.

Berlin, July 26.

Circulatory Movements in Liquids.

FROM a manuscript by Christiaan Huygens, containing the description of his microscopical observations in the year 1678, I quote the following passages:—

"5 Sept. Et ayant mis de petites goutes rondes de cette urine sur le talc" (we read at another place: "ayant pris de cette eau et mis dans le microscope entre le verre et le talc"), "Je remarquay avec le microscope que ces œufs, et sans doute la liqueur mesme avec eux, avoient un mouvement continuel par lequel ils montoient dans le milieu AB de la goute et puis descendoient par les deux costes CD, et montoient ensuite encore par AB, et ainsi toujours, car je suivois ces graines, et vis que c'estoient les mesmes qui montoient et descendoient.

"Cette continuation de mouvement est estrange et ressemble a celle de la matiere qui passe a travers l'aimant" (according to Huygens's theory of magnetism, which will be published in one of the volumes of his "Œuvres Complètes"). "Je mis par 3 fois des gouttes nouvelles et vis toujours la mesme chose. Les jours suivants ce mouvement n'estoit pas si manifeste.

"9 Sept. Dans du jus de resins blancs, et noirs, mis en expérience le jour d'auparavant, rien de vivant, mais bien de parties grasses et heterogenes, par lesquelles je remarquay le mouvement dans ce jus que j'avois vu dans l'urine le 5 Sept.

"10 Sept. Jus de resins rien de vivant. Le mesme mouvement y estoit.

"11 Sept. Dans le jus de resins rien de vivant, le mouvement de circulation de mesme que le 10e."

Have such phenomena been observed by other microscopists? Any suggestions about their precise cause would be very welcome.

The manuscript will be published in the next volume of Huygens's "Œuvres," which is in an advanced state of preparation.

Amsterdam. D. J. KORTEWEG.

NATURAL HISTORY AND THE OCEAN.[1]

(1) THIS is a new work on birds by the distinguished ornithologist, Dr. Anton Reichenow, of Berlin, which when completed will consist of two volumes. This, the first, contains a general review of the class Aves, followed by a systematic account of the Ratitæ, Natatores, Grallatores, Cutinares (Deserticolæ, Crypturi, Rasores, Gyrantes), Raptatores, and Fibulatores. Excellent line sketches illustrating special diagnostic characters are imbedded pleasantly in the text. Each family, with the genera included in it, is concisely characterised and its geographical distribution indicated, while of the species the more important are enumerated often with remarks on those of special interest. When finished "Die Vögel" will form, if not a "handbook," at least a compact and useful synopsis of systematic ornithology. Unfortunately, like so many German publications it can scarcely be said to be "bound," for with very little provocation it collapses into an inchoate mass of sheets.

(2) This will prove an invaluable book of reference for all who may have to study the avifauna of not only Australia, but of the southern hemisphere, notwithstanding that many of Mr. Mathews's co-workers will probably disagree with him in the distinctness of the numerous, and, as we think, too numerous subspecies he describes. The introduction provides us with a very interesting ornithological history of Australia, and an important discussion of the faunal regions into which the continent appears to be divided from the point of view of its birds. We observe that he recognises, as we believe rightly, the existence in Australia of an element derived from, or once forming, part of an ancient antarctic continent, then possessing a climate very different from that now existing. The nomenclature adopted by the author follows the several rules of strict priority formulated by the different international zoological congresses of recent years, and of necessity, therefore, sweeps away many names which we cling to from being familiar to us for more than half a century, and which we relinquish, if relinquish them we must, with the deepest reluctance.

Mr. Mathews's "List" represents an amazing amount of the hardest and driest kind of work (to all appearance done once for all), which only those who have some experience in threading the mazes of synonymy can appreciate, and for this ornithological literature must be grateful to him *in saecula saeculorum.*

(3) This is a very disappointing book, full of loose and unqualified dogmatic assertions, such, for example, as: "Many [sea-birds] have for so long a time resorted to rocks . . . that though they may be active enough as swimmers and divers when upon or in the water, they are strangely laborious upon the wing. . . ." How about gannets, pelicans, many cormorants, terns, guillemots? The illustrations are very rough reproductions of pen-and-ink drawings.

(4) Dr. G. A. Boulenger is too well known an authority on the reptilia for anyone to be in doubt as to the value of this volume. "There is no work in the English language," the author informs us in the preface, "dealing with the reptiles of Europe. I have, therefore, endeavoured to supply this desideratum so far as the snakes are concerned." His account of the species found in Europe is preceded by a concise and very excellent introduction, summarising what is known of snakes generally, dealing with their external characters, their anatomy, reproduction, habits, distribution—of which one remarkable fact stated is that the zoogeographical regions into which the world is usually divided do not lend themselves any better than the ordinary divisions of physical geography to the study of the distribution of snakes—and finally, their relation to man. The systematic account is illustrated by a beautiful figure of each species, drawn by Prof. Sordelli, of Milan, for his own and Prof. Ian's "Iconographie Générale des Ophidiens," and reproduced in this volume with his permission.

(5) Mr. B. B. Woodward's "Life of the Mollusca" is another addition to the same excellent series being issued by Messrs. Methuen, to which Dr. Boulenger's belongs. The work gives a succinct account of the history, relationships, and everyday life, with general notes on the anatomy, classification, and distribution of this group of the animal kingdom. The classification here given is based mainly on conchological characters; but in the Mollusca this is never felt to stand on quite the same certain basis as that in other zoological groups, inasmuch as so many of the species are determined upon the house they inhabit, and not on the inhabitants themselves. A very remarkable instance of such a discrepancy was recently discussed in a paper before the Zoological Society, in which the conchological relationships of a new species of Papuina from New Guinea disagreed with those indicated by its anatomical characters. The volume is well illustrated by more than thirty plates, most of the figures of which originally

[1] (1) "Die Vögel." Handbuch der Systematischen Ornithologie. By Anton Reichenow. Zwei Bände. Erster Band. Pp. viii+529. (Stuttgart: Ferdinand Enke. 1913.) Price 15 marks.
(2) "A List of the Birds of Australia." By G. M. Mathews. Pp. xxvii+453. (London: Witherby and Co., 1913.) Price 10*s*. net.
(3) "The Wonders of Bird-life." By W. Percival Westell. Pp. 128. (Manchester: Milner and Co., n.d.) Price 1*s*. net.
(4) "The Snakes of Europe." By Dr. G. A. Boulenger. Pp. xi+269+plates. (London: Methuen and Co., 1913.) Price 6*s*.
(5) "The Life of the Mollusca." By B. B. Woodward. Pp. xi+158+plates. (London: Methuen and Co., 1913.) Price 6*s*.
(6) "The Peregrine Falcon at the Eyrie." By F. Heatherley. Pp. x+78. (London: *Country Life*, 1913.) Price 5*s*. net.
(7) "The Holiday Nature-book." By S. N. Sedgwick. Pp. 355+plates. (London: C. H. Kelly, n.d.) Price 3*s*. 6*d*.
(8) "The Ocean: A General Account of the Science of the Sea." By Sir John Murray. Pp. 256+xii plates. (London: Williams and Norgate, n.d.) Price 1*s*. Home University Library.

appeared in the late Dr. S. P. Woodward's well-known "Manual of the Mollusca."

(6) In this volume Mr. Heatherley describes minutely and illustrates fully by a wealth of pictures taken—during successive seasons—from hour to hour during daylight from an adjacent but concealed observation shelter, the intimate nesting history of the Peregrine Falcon from the time the eyrie was tenanted and the eggs laid until the young hatched out and were fed to maturity. The monograph forms an interesting and very valuable record of a long watch pursued with great conscientiousness and endurance, regardless of the many discomforts which it entailed, by the author and his friends who from time to time mounted guard in his place. Mr. Heatherley notes as a previously "unrecorded fact that after the first few days the falcon turned over to the tiercel the duties of her sex, spending his time abroad hunting and bringing the quarry to the tiercel who remained at home to feed and look after the young." As the book is one of the series of studies issued by *Country Life*, it is needless to state that the illustrations—one of which is reproduced, by the courtesy of the publishers—are up to the high standard that we are accustomed to in that journal. It is a pity, we think, that in a work of this character some of the pages should be furnished with very frivolous headlines.

Young Peregrine Falcons, twenty-nine days old. From "The Peregrine Falcon at the Eyrie."

(7) The next volume on our list is written for the "increasing number of people, young and old," who "are interested in popular nature-study." Nearly half of its contents deals with objects of the sea-shore; the remainder is devoted to birds of the garden, spiders, beetles, and moths. Two chapters are given up to nature photography and how to photograph small objects. A specimen nature calendar, with the chief notabilia for each month of the year, partly filled up and left to be completed by the reader, is included. So far as sampled, the information is accurate, and is conveyed in language understandable by those for whom the book is designed. Some of the photographic reproductions might be improved upon.

(8) A book on the ocean by Sir John Murray—

the greatest investigator of the deep and the highest authority on all that concerns the science of the sea—would seem to require no more in the way of review and recommendation than the mention of that fact. Yet it may be well to state that within the compass of 256 pages of thirty lines each we have perhaps the most concise and the most scientific account of this immense subject that has yet been written, set forth in language that the reader most unfamiliar with the subject can grasp with perfect facility. In being, alas! the final contribution to science, we believe, from John Murray's pen, it is sadly appropriate as a summing up of the work to which his long, arduous, and brilliant scientific life was devoted. Its various chapters deal with the methods and instruments of deep-sea research, the depths of the ocean, the physical characters of its waters, oceanic circulation, life in the ocean, marine deposits, and the geospheres. A glossary, a concise bibliography, and a sufficient index close the volume. It is more fully illustrated than most of its predecessors. There are twelve plates, of which six are coloured maps by Bartholomew of wonderful clearness notwithstanding their size, showing the deeps, the salinity, the surface temperatures, the currents, the surface density, and the deposits of the ocean.

THE ADMINISTRATIVE PROBLEM OF SLEEPING SICKNESS.

The Report of the Inter-Departmental Committee on Sleeping Sickness (Cd. 7349, price 3*d*.), recently published, is a most valuable summary of present knowledge on the subject. The committee have taken the evidence of all the leading authorities on the subject, both British and foreign, and the enormous mass of evidence put before them (printed separately as Cd. 7350) has been very carefully sifted and analysed in the Report, which is signed by all members of the committee with certain reservations by two of them (Dr. W. A. Chapple, M.P., and Mr. J. Duncan Millar, M.P.), who have appended a separate memorandum embodying their opinions with regard to the game question.

The following are some of the opinions or recommendations expressed by the committee with regard to controversial questions either of scientific knowledge or practical administration.

The problems which arise with regard to trypanosomiasis in man in Nyasaland and Rhodesia are wholly distinct from the problems which arise in Uganda. Nyasaland trypanosomiasis is caused by *T. rhodesiense* and conveyed by *Glossina morsitans*; it is a very small factor in the general bill of mortality; it is probably an old and endemic disease, and there appears to be no evidence to indicate that it is likely to become epidemic. On the other hand, Uganda trypanosomiasis is caused by *T. gambiense* and conveyed by *G. palpalis*; it has been known on the west coast of Africa for at least one hundred years, but was first introduced into Uganda at the end of the last century, probably by infected native porters coming from the Congo, and it is believed to have destroyed about 200,000 natives between 1898 and 1906. There is a general agreement among experts that Uganda trypanosomiasis is not endemic beyond the range of *G. palpalis*. *T. rhodesiense* infection is much more virulent than *T. gambiense* infection. All authorities believe the diseases to be distinct, though allied.

The committee considers that the elimination of Glossina as the carrier must be the principal object of all efforts to check or get rid of the disease. The evidence all points to the conclusion that if the tsetse-fly could be eliminated or removed from contact from human settlement, sleeping sickness would practically disappear, infection conveyed by other flies being a negligible factor in the spread of the disease. For this reason the committee attach great importance to a proper and sufficient equipment of entomological research into the bionomics of the incriminated tsetse-flies. This form of research has, in their view, been insufficiently pursued up to the present time. In this form of research there is a large element of chance; accident may at any time lay bare a result which may lead to the solution of the problem, and the multiplication of the workers is the multiplication of chances.

With regard to the vexed question of the reservoir and the advisability or otherwise of game-destruction:—(1) As regards Uganda trypanosomiasis, there is abundant evidence that human beings, infected but able to get about, serve as reservoirs of the virus, maintaining the endemicity of the disease, and that they may in travelling distribute it widely. There is also evidence that in the absence of men wild animals may be a source of the virus. It is doubtful how much importance should be attached to the antelope as a reservoir of *T. gambiense*. The part this reservoir plays is probably small in comparison with infected man, and to a less extent his domestic animals; for cattle, sheep, and goats have been known to harbour this trypanosome and take no harm.

(2) As regards Nyasaland trypanosomiasis, the committee consider the identity of *T. rhodesiense* with the similar trypanosome found in game, in the same districts, as unproven. The wild animals in question are undoubtedly reservoirs of the trypanosomes pathogenic to stock; but the evidence is conflicting as to whether the wild animals which are a reservoir of the disease affecting domestic stock are a danger to man. Knowledge of the disease, its cause, and its remedies, is still in the making, and hasty and imperfectly considered action of a drastic character such as the attempt to effect a general destruction of wild animals is not justified by the evidence before the committee. In Nyasaland and Rhodesia the incidence of the disease on the population is slight and it is not increasing.

The proposed experiment of removal of wild animals from a selected area may produce valuable results, both as regards knowledge of the habits of the fly, and as to the extent to which the infectivity of the fly and subsequently the infection of man or stock is derived from wild animals. The result of this experiment cannot be confidently anticipated, but, nevertheless, the committee think there is sufficient to justify an expectation of useful results and recommend that if a suitable locality can be found where an experiment can be carried out at a reasonable cost, it should be undertaken.

RECENT STUDIES OF THE ATMOSPHERE.[1]

THE German Meteorological Society offered a prize for the best essay on the results of the International Kite and Balloon ascents, and the prize was won by Mr. Gold in 1912 by the memoir which is now published by the Meteorological Office. The results mostly refer to ascents which took place prior to December, 1909, but in the case of some stations observations are included up to November, 1911. From an exhaustive consideration of the temperature in the free air and its relation to pressure at sea-level, geographical position, and season, it appears that in Europe August is, in general, the warmest month in the troposphere, and March the coldest, except close to the surface; thus, the temperature lag is greater for the minimum than for the maximum, which, as is pointed out in the memoir, is to be expected, for convection can carry warmth upwards, but not cold. It has become apparent from the study of the upper air that a cyclone is colder than an anticyclone, and this is borne out by Mr. Gold's figures; he finds that a cyclone is colder than an anticyclone up to ten kilometres, that is, up to the level of the stratosphere.

The height at which the stratosphere is found, and its temperature, are known to vary with the surface pressure; the higher the pressure the higher is the lower limit of the stratosphere and the lower the temperature of the layer. Mr. Gold has investigated this point in detail and gives diagrams showing the changes in the stratosphere in height and in temperature through areas of high and low pressure, both in winter and summer. The places where sounding balloons fall show that the general drift of the wind over Europe is from the north-west in the upper air. Balloons sent up in easterly winds usually fall to the east of the starting place in winter, showing that at this season an easterly current is shallow, the pressure gradient above being reversed by the gradient of temperature from south to north. Mr. Gold discusses many questions of the winds and the dynamics of the atmosphere, but it is impossible in a short notice even to indicate every point in the work; it should be read by all interested in dynamical meteorology.

Almost all the observations in the upper air in this country are made with Mr. W. H. Dines's light meteorograph. In Geophysical Memoir, No. 6, Mr. Dines describes very fully the method of calibrating, preparing the instrument for the ascent, and working up the trace. With these instructions and those given in a former publication of the Meteorological Office (M. O. 202) an observer should be able to use the instrument to full advantage

Electrical observations of the atmosphere at the new observatory at Eskdalemuir are discussed by Mr. Dobson in the Geophysical Memoirs, and compared with those at Kew. Conditions differ in several respects, being far more disturbed at the northern station. The diurnal curves of the potential gradient for the two stations are similar during the winter, but differ markedly in the summer; at this season the potential at Eskdalemuir is high at night and begins to fall in the early morning when it is rising to a maximum at Kew. The mean absolute value of the potential gradient is always higher at Kew than at Eskdalemuir, which Mr. Dobson attributes chiefly to the abnormally low conductivity of the air at Kew. The small and uncertain difference in the number of ions between summer and winter at Eskdalemuir is remarkable. The station has not been long established, and the account given in this memoir will, no doubt, be amplified when a longer series of observations from Eskdalemuir is available.

The constriction in the tube of the marine barometer, made to avoid oscillations of the mercury, causes a lag which is discussed by Dr. Chree in No. 8 of the Geophysical Memoirs. The theory was considered by Stokes, who found that the marine barometer had a certain "lagging time." If the sluggishness were due to the constriction alone the lag should be too small to affect readings in practice. But Dr. Chree has investigated the problem by the consideration of the readings of a number of barometers tested at Kew, and finds the lag to be considerably greater than according to Stokes's formula. Further observations with the same result were made with two barometers which were subsequently put on board ship, and read every four hours by the ship's officers during a number of voyages across the Atlantic; the lag at sea was found to be much less than on land, and was almost entirely confined to cases where the barometer was "pumping." No explanation is put forward to account for "the extraordinary difference between land and sea results." Dr. Chree is not of opinion that it can be explained by uncertainties of reading at sea. Further observations are hinted at, and it is certainly desirable to find out why on land the lag should be "enormously greater" than given by Stokes's formula, while at sea it is "exceedingly small."

[1] Geophysical Memoirs (Meteorological Office):—
No. 5. The International Kite and Balloon Ascents. By Ernest Gold. (1913.) Price 1*s.* 6*d.*
No. 6. The Free Atmosphere in the Region of the British Isles (Third Report). The Calibration of the Balloon Instruments and the Reading of the Traces. By W. H. Dines, F.R.S. (1914.) Price 3*d.*
No. 7. A Comparison of the Electrical Conditions of the Atmosphere at Kew and Eskdalemuir. By Gordon Dobson. (1914.) Price 8*d.*
No. 8. Lag in Marine Barometers on Land and Sea. By Dr. Charles Chree, F.R.S. (1914.) Price 4*d.*

NOTES.

THE *Endurance*, with Sir Ernest Shackleton and the Imperial Trans-Antarctic Expedition on board, left London on Saturday last. The vessel will leave Plymouth for the Antarctic on Saturday next with a crew of seventeen, and six or eight members of the Weddell Sea-shore party. The remaining members of this party will sail in the middle of September by mail steamer for Buenos Aires.

WE learn from the *Times* that the Scottish Spitsbergen Expedition, under the leadership of Dr. W. S. Bruce, director of the Scottish Oceanographical Laboratory (referred to on p. 512 of NATURE, July 16), left Tromsö on the morning of July 24. Dr. Bruce has chartered the sailing ship *Pelikane*, and is proceeding to Wybe Jansz Water, where he will land a party under the direction of Mr. R. M. Craig on the east coast of the mainland. From there he will go with the ship to Green Harbour, Ebeltoft Harbour, and Prince Charles Foreland. Dr. Bruce will return with the *Pelikane* to Wybe Jansz Water to continue the hydrographic survey of the loch, while Mr. Craig, it is hoped, will be able to carry on the geological researches, which he will have begun during Dr. Bruce's absence in the west.

AN expedition under the leadership of Miss M. A. Czaplicka, who holds a travelling fellowship of Somerville College, Oxford, is being sent out by the Universities of Oxford and Moscow, for the purpose of studying the tribes of the Yenesei region. The other members are Mr. H. A. Hull, of Philadelphia University, in charge of physical anthropological work; Miss Haviland, zoologist and ornithologist; Miss Curtis, photographer. The tribes which will be investigated are the Tungus and Ostiak of the Yenesei, both with Mongoloid affinities, though physically distinct. The question of group marriage, peculiarities of the tribal wizard, and their religion are included in the scope of the inquiry. The expedition will be absent for about a year, and is supplied with carefully selected equipment and provisions.

IT is stated in *Science* that Mr. C. Boden Kloss and Mr. H. C. Robinson, director of museums, Federated Malay States, are engaged in an expedition to Mount Indrapura or Korinchi in Central Sumatra —a volcano 12,700 ft. high, and the highest summit in the island. The objects of the expedition are zoological and botanical, but it is hoped to ascend to the summit of the mountain and make observations of the crater and the present activity of the volcano.

WE learn that the committee of the Capt. Scott Memorial Fund has accepted the offer of the Admiralty of a site at Greenwich Hospital for the erection of the memorial to the explorers who lost their lives in the Antarctic region. It has been stipulated by the Admiralty that the memorial shall harmonise with the architecture of neighbouring buildings.

THE death is announced, at the age of sixty-seven, of M. Paul Reclus, who was largely instrumental in making general the use of cocaine as an anæsthetic in surgery. He was elected a member of the Paris Academy of Medicine in 1895.

MR. JOHN HOOD, whose recent death, at an advanced age, is announced from Dundee, was well known to many zoologists and microscopists as a collector of the more minute forms of fresh-water life and especially of the Rotifera. The study of these attractive little animals was the hobby of his life, and though he published little under his own name, he gave very important assistance to many other workers. It is only necessary to turn the pages of Hudson and Gosse's great Monograph to see how largely they were indebted to him for the material on which they worked, and his name is quoted on almost every other page as authority for some statement regarding the bionomics or occurrence of a species. He was especially successful in obtaining new and curious forms of the sessile Rotifers forming the group Rhizota, which in recent years have been somewhat neglected in favour of the more easily collected free-swimming species. Mr. Hood was a mechanic by trade, and in his later years, when laid aside from work, he was in straitened circumstances, and sometimes perilously near actual privation. Only a year ago, a small pension from the Murdoch Trust, obtained at the instance of some of his scientific friends, brought ease of mind and some comfort to his last days. Probably very few of his numerous correspondents knew him personally, but those who did know that he represented a particularly fine type of the "working-man naturalist," a type which is, perhaps, commoner in the north country than in the south, and which was more characteristic of the nineteenth century than it promises to be of the twentieth.

As already announced (see NATURE, December 18, 1913), an International Congress of Meteorology is to be held in Venice in September next. From a circular just received, we learn that the Congress will take place on September 17, 18, and 19, and will be divided into three sections, dealing respectively with climatology and agrarian meteorology; aerology; general and maritime meteorology. The communications and discussions are to be in English, French, German, or Italian, and those intending to take part must send their applications and subscriptions to the secretary of the executive committee (Osservatorio Patriarcale della Salute, Venice) before August 31. The subscription will be 10 lire (8*s*.).

THE fourteenth French Congress of Medicine is to be held at Brussels on September 30, October 1, 2, and 3. The president will be Prof. Henrijean, of Liége, and the general secretary Prof. R. Verhvogen, 22 rue Joseph II., Brussels. Among the subjects to be discussed are cardio-vascular syphilis; vaccinotherapy in general, and in particular vaccinotherapy of cancer and typhoid fever; the therapeutic value of artificial pneumothorax; lipoids in pathology.

AN illustrated lecture on the modification of response in plants under the action of drugs is to be delivered on October 30 before the Royal Society of Medicine by Prof. J. C. Bose, of Calcutta.

THE thirteenth competition for the Riberi prize, the value of which is 800*l*., is now open. It is to be awarded for scientific researches in medical science, and is given under the auspices of the Royal Academy of Medicine of Turin. Names of competitors will be received until December 31, 1916. Entry forms may be obtained from Dr. V. Oliva, secretary of the Royal Academy of Medicine, 18 Via Po, Turin.

Lord Salvesen, the president of the Scottish Zoological Society, has intimated his willingness to bear the cost (estimated at about 1000*l.*) of the erection of a house in the Zoological Park for the accommodation of the smaller and more delicate mammals.

A City Guild has been established at Coventry having as its object the preservation of historic buildings and places of natural beauty. It will work upon the same lines as the society as Stratford-on-Avon which, though only two years old, has already done good work.

We have received from the British Association Committee for Radiotelegraphic Investigation copies of the programme of observations to be made during the total solar eclipse of August 21 next, and of the three forms, A, B, and C, which have been issued by the committee for use during the eclipse. Form A is for records of the measurement of signal strength; form B gives instructions and explanatory remarks concerning graphic records; and form C is for observations on strays. It should be mentioned that on the occasi n of the eclipse, five high-power wireless telegraph stations in Europe will each make a series of special emissions to provide facilities for the observation of strays, and for the measurement of the strength of signals—hence the issue of the above-named documents. It is requested that experimenters in wireless telegraphy possessing such apparatus of precision as will enable them to make accurate measurements will communicate with Mr. W. Duddell, 56, Victoria Street, S.W. Prospective observers, willing to make aural estimates of signal strength, or to make observations on strays (either by the graphic record method, or by the method of registering the number heard during every thirty seconds), should intimate their willingness and state which portion of the observations they can undertake, to the honorary secretary, British Association Radiotelegraphic Committee, 88, Gower Street, W.C. They should also state the number and the names of the five sending stations with which it would be most convenient for them to work.

The report of the Astronomer-Royal to the Board of Visitors has been issued as a White Paper. In it it is stated that the old time ball at the Royal Observatory, Greenwich, is to be replaced by a new aluminium ball. The time ball was first erected in 1833. An electric current from the clock was first used to drop it at 1 o'clock in 1852. In 1855 the ball was blown down into the courtyard. Some repairs were made in 1895, when the chain broke during winding, and again, in August, 1913, some temporary repairs were made to the ball.

The President of the Local Government Board has authorised the following researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease. These are in addition to the investigations already announced:—(1) an investigation of the details of the technique in carrying out Wassermann's reaction for the diagnosis of syphilis. Major Harrison, acting in collaboration with a subcommittee of the Pathological Section of the Royal Society of Medicine, will carry out this investigation. (2) An investigation by Mr. H. J. Gauvain, in collaboration with the Board's pathological staff, into the cutaneous tuberculin reactions of cases of tuberculosis of bones and joints of bovine and human sources. (3) A continuance of the investigation of Drs. Twort and Mellanby on infantile diarrhœa, with special reference to the conditions governing the absorption of toxic substances from the alimentary canal. (4) A further investigation into the causes of still-births by Drs. C. J. Lewis and Dale.

An extremely interesting presidential address on "The Service of Medicine to Civilisation" was delivered by Prof. Victor Vaughan before the American Medical Association in June (see *Science*, July 3, 1914). One statement of importance is made, viz., that infectious disease picks out the fit rather than the unfit, and therefore does not benefit the race by the elimination of the unfit. Prof. Vaughan claims increased state-aid for scientific investigation, and says that he has no sympathy with the idea that medical research should be largely relegated to special non-teaching institutions, for the man who is devoid of the spirit of scientific investigation should have no place in medicine as student, practitioner, or teacher!

We have received No. 4 of the *Indian Journal of Medical Research*, which completes the first volume of this important publication. It contains a number of papers on tropical research, and is well produced and illustrated.

Two circulars which we have received serve as an illustration of what can be done, and is being done, in the study of nature in and around London. One is from Prof. Flinders Petrie, president of the Hampstead Scientific Society, pointing out the danger of extermination of the majority of the animals and plants in the parts of North London which are now being rapidly built over, and appealing for assistance from residents in and visitors to the district in the attempt of the Hampstead Scientific Society to compile a complete record of the natural species still to be found within three miles of the flagstaff on the summit of Hampstead Heath, communications to be made with the secretaries of the society at 32 Willoughby Road, Hampstead. The second circular is from the curator of the Whitechapel Museum, 77 High Street, E., and consists in a description of the arrangements made for visits of school classes to this museum and to the Nature-Study Museum, both being controlled by the borough of Stepney. Nearly two thousand school classes have visited the museums mentioned during the last four years, while both are available for school visits, the Nature-Study Museum confines itself mainly to the display of living plants and animals, the grounds containing many fine trees and also a wild flower garden with a large collection of growing British plants labelled by their common names, and in addition to an observation beehive, a large vivarium with reptiles and batrachians, and a collection of the score or so of wild birds which visit or nest in the grounds, there are about seventy fresh-water and marine aquaria, containing a fine series of aquatic plants and insects, mollusca, anemones, and fishes.

Mr. W. W. Smith has contributed to the Records of the Botanical Survey of India (vol. iv., No. 7) an interesting account of the alpine and subalpine vegetation of south-east Sikkim, more especially that of the ridges lying between the two passes, Cho-La and Tanka-La. The list of the 925 species of flowering plants and ferns collected is preceded by an exceedingly interesting general description of the flora of this high region, with reference to the climatic and other conditions of the area, one of the wettest in the Himalayas.

We are glad to learn that the marine biological investigations at the Cape of Good Hope, which were suspended, in part at any rate, for some years, have again been resumed under the direction of Dr. J. D. F. Gilchrist. The Marine Biological Report, No. 1, has now been issued, and contains two papers of considerable economic interest. The first of these is on the Cape crawfish and the crawfish industry. The somewhat changeable history of the industry is recorded, and the prospects of future development discussed. The main part of the paper is, however, devoted to a study of the natural history of the species, which leads up to a consideration of the possible ways in which the industry may be preserved. The second paper contains an account of the various species of the herring and allied families, which live in Cape waters. The number of these is considerable, but it does not seem probable that many of them offer a prospect of a successful fishery.

To the July number of the *American Naturalist* (vol. xlviii., p. 385) Dr. Glover M. Allen contributes the first part of a remarkably interesting and original article on the development of colour-pattern in mammals and birds, dealing in this instance almost exclusively with the development of semi-albinism in domesticated mammals. In the opinion of the author, mammals and birds have five paired centres of maximum development, and a single azygous frontal centre. Where these areas come into contact with one another, that is to say, on their peripheries, the intensity of the pigmentation is, of necessity, much less than at the centres. A consequence of this is the tendency to the development of non-pigmented areas at the lines of junction, such light tracts being denominated "primary breaks." One of such unpigmented areas occurs on the middle line of the lower surface of the body; there is another between the ear-patches, and a third on the side of the neck. In piebald horses and cattle an unpigmented tract is very generally situated in the neighbourhood of the shoulder, and another in the lumbar region, one or both of which may embrace the associated limb. How very closely the colour-pattern of horses agrees in this respect with that of cattle is made apparent by the figures with which the article is illustrated, and it will not fail to be noticed that the two main light tracts approximately follow the lines of the limb-girdles, as was pointed out years ago by a writer to whom the author appears to make no reference. "Dappling" in horses, which has been regarded as an archaic feature, is considered by Dr. Allen to be more probably a secondary development.

Dr. Rolf Witting continues to carry out most valuable hydrographical work in the Gulf of Finland, and in *Finlandändische Hydrographisch-Biologische Untersuchungen*, No. 12, the observations for the year 1912 are published. As in former years, salinity and temperature observations have been made on special cruises, as well as more continuous series of observations on lightships. The ice conditions are also fully recorded. Finland is to be congratulated upon having carried out its hydrographical work for a number of years in a thorough and systematic way, being in many respects considerably ahead of some of the larger countries that took up this work in 1903, in connection with the International Fishery investigations.

To the April issue of the Proceedings of the Philadelphia Academy Dr. N. E. McIndoo contributes a long article on the olfactory sense in Hymenoptera, as exemplified by ants and hornets. The special object of the experiments on which the article is based was to establish, in the first place, the relative sensibility of these insects to various odours; secondly, to ascertain the situation of the olfactory organs; and, thirdly, to determine how other Hymenoptera compare with ants and hornets in the perception of scents. Various opinions have been held with regard to the seat of smell in insects, but the general view at the present day is that this is situated in the antennæ, although it has been pointed out that since these appendages are coated with hard membrane, they are ill-fitted to receive and assimilate olfactory stimuli. Dr. McIndoo finds that the so-called olfactory pores of the legs and wings are the true smelling organs, and that the antennæ take no part in the olfactory function.

Publication No. 192 of the Carnegie Institution includes (p. 263) a contribution by Dr. Ch. Schuchert on the "Climates of geologic time," in which much attention is paid to the occurrence of glacial epochs from the "proterozoic" periods to recent times. The author regards crustal deformations, which may possibly be rhythmic, as the most potent cause of climatic change. Dr. Schuchert, in association with Prof. Barrell, has just issued another paper of wide import, "A revised geologic time-table for North America" (*Am. Journ. Sci.*, vol. xxxviii., 1914, p. 1), which also emphasises the conception of rhythmic movements of the surface. These produce marked changes in the fauna, especially on land. The table summarising our knowledge of pre-Cambrian history will be useful to many teachers.

Prof. W. H. Hobbs has published, through the Macmillan Company of New York (price 1s.), a pamphlet on "Simple Directions for the Determination of the Common Minerals and Rocks," with an appendix on geological maps and models; the use of wooden blocks, the inclination of which can be varied, to represent the outcrop of strata is distinctly suggestive. A student of geology should know much more about the foundations of mineralogy than is here given; but these pages were originally drawn up as a supplement to the author's physiographic work on "Earth Features and their Meaning."

Mr. H. Dewey's well-illustrated account of the geology of North Cornwall, in the Proceedings of the Geologists' Association, vol. xxv. (1914), part iii., will aid many visitors to the county. The conspicuous plain that cuts across the structure of the country at 300 to 400 ft. above the sea is regarded as due to marine denudation occurring in Pliocene times. A steep bluff represents the coast-line limiting this plain. Mr. T. C. F. Hall adds a petrological study of the St. Austell granite, in which the important problem of kaolinisation is discussed.

Geologists may note in *Fortschritte der Mineralogie,* for 1914, an elaborate review, by M. Stark, with a bibliography of 534 entries, on the question of petrographic provinces. From the work of Judd in 1876, who is quoted in the bibliography as "W. Judd," we are brought through a large number of regions where relationships have been claimed for igneous rocks of diverse characters. As a result of this survey, two main groups, already unfortunately named by Becke Atlantic and Pacific, are held to be well established, and we are led to understand that an original magma combining these materials no longer exists as an important feature of the crust. The author concludes that the Pacific type dominated in early geological ages, while the Atlantic type has been brought almost to an equality with the Pacific since Eocene times, and will ultimately prevail completely over it.

The Geological Survey of New Jersey, under the care of Dr. H. B. Kümmel, has issued a "Geologic Map" of the State on the scale of 1 : 250,000. The general strike of the beds, whether Palæozoic or Mesozoic, is north-east and south-west, and influences one great feature of the country, the course of the Delaware River, which forms the frontier for fifty miles along the foot of Cretaceous escarpments. The Hudson on the east similarly works down along the strike under the famous Triassic dolerite "palisades." The choice of colours gives a highly artistic character to the map.

It is frequently observed that in certain conditions of the atmosphere unusual visibility of distant objects exists. In *Symons's Meteorological Magazine* for December last, Mr. S. Miller referred to the phenomenon and asked what are the physical conditions that produce it, and whether it is admitted to be a prognostic of rain. An interesting discussion followed, in which several well-known men of science have taken part. Opinions as to the prognostic are about equally divided. Mr. W. H. Dines (Mag. for June) thinks visibility is more prevalent in rainy weather, but after, just as much as before, rain. Also, that haziness is dependent on the character of the district from which the air comes; smoke from the London or Clyde districts can be traced for a hundred miles. Dr. John Aitken (Mag. for July) concludes, from a large number of observations at Falkirk (Stirling), that transparency is adversely affected (1) by humidity, and (2) by the density of the population in the direction from which the wind blows. There is, however, no doubt as to the general popularity of the rain prognostic; a former careful observer (Rev. G. T. Ryves), referring to the well-known rhymes sometimes ascribed to Dr. Jenner, and including the line: "The distant hills are looking nigh," remarks that visibility is "one of the most generally accepted signs of rain."

Since their systematic classification by Luke Howard in 1803 and the modifications introduced by international agreement in recent years, the observation of the forms and motions of clouds has become one of the most important aids to successful weather study, and Prof. W. Davis remarks in his excellent "Elementary Meteorology" that "if the observer wishes to learn something of atmospheric processes for himself, he should give at least as much time to cloud observations as to all other records put together." We therefore welcome an interesting address to the Occidental College on the clouds of California by Dr. F. A. Carpenter, local forecaster of the U.S. Weather Bureau. Although occupying only eighteen pages it contains much useful information on the composition and formation of clouds. To the usual nomenclature he adds a local form: *el velo,* sometimes known as "high fog," which occurs morning and evening between May and September along a large part of the coast. Storm clouds are most frequent over the northern portion of the State, where cloudless days average less than 100 in a year; in the southern part, *e.g.*, at San Diego, there are nearly 300 cloudless days. Notwithstanding the proverbial sunny skies of California, the author states that most of the known varieties of cloud can be observed there.

The current *Bulletin* of the Imperial Institute (vol. xii., No. 2) contains among the reports of recent investigations by the scientific and technical staff the results of the examination of soils from Nyasaland, of penguin guano from the Falkland Isles, and of flax from the East Africa Protectorate, where there is every prospect of the cultivation of this fibre becoming established in Nyanza Province. Other reports relate to cocoa from Nigeria, copals from British West Africa, and cohune nuts from British Honduras. Coffee cultivation in Uganda is dealt with by Mr. W. Small, botanist of the Department of Agriculture in this colony. Coffee is now the staple crop of European planters in Uganda. The area is being extended, and large increases in the exports of coffee may be shortly looked for. An article on the utilisation of fish and marine animals as sources of oil and manure discusses the composition and uses of fish oils, their sources and preparation, and describes the present position of the whaling industry. Fur farming in Canada and the tin resources of Malaya and India are dealt with in separate articles. Considerably more than half of the world's supply of tin is now produced within the British

Empire; the output in 1911, the latest year for which final figures are obtainable, was: British Empire 60,497 tons, foreign countries 54,051 tons.

No. 3 of vol. viii. of the *Biochemical Journal* contains two papers, emanating from the Lister Institute, of great general interest. The first, by Mr. Evelyn Ashley Cooper, deals with the curative action of autolysed yeast on avian polyneuritis; the solution obtained retains its curative power for at least eight weeks, and is apparently quite non-toxic. The autolysis of brewers' yeast should therefore afford a simple, inexpensive method of preparing a solution suitable for the oral treatment of human beri-beri. The second paper deals with the bases of gas-works tar, which are believed to be the predisposing cause of pitch-cancer, with special reference to their action on lymphocytes, and a method for their inactivation. The bases which are capable of exciting cell-division are found to occur in the anthracene fraction of the tar, and two bases of this kind have been isolated in the form of picrates, but have not yet been identified satisfactorily. A simple method of rendering these bases inactive consists in heating the tar to a temperature of about 160°, and blowing ordinary or ozonised air through it; in this way the auxetics are rendered harmless by oxidation.

For many years considerable inconvenience has been experienced in the sheet-metal trade in consequence of misunderstanding as to the recognised gauge for iron and steel sheets and hoops. A series of sizes known as the "B.G." gauge, or Birmingham gauge, was adopted by the South Staffordshire Ironmasters' Association in 1884, and were very generally accepted in the trade concerned; but many buyers have persisted in ordering sizes belonging to other systems, such as the "B.W.G.," or Birmingham wire gauge, which has no legal status, and is often confused with the imperial standard wire gauge legalised in 1883. Neither of these gauges is, however, recognised in the iron trade for sheets and hoops, and, in consequence, mistakes have often been made, leading in some cases to litigation. At the instance of the metal trades section of the London Chamber of Commerce, the Board of Trade was approached in 1912 with a view to the legalisation of the "B.G." gauge, and, after consideration, they decided in August last to prepare the necessary order in council. This order in council has now been issued, and comes into operation on November 1 next, on which date all the "B.G." sizes from 15/0 B.G., or 1 in., to 52 B.G., or 0·00095 in. will become legal denominations of imperial measure, and will accordingly be admissible for verification and stamping by inspectors of weights and measures. In the interest of the metal trade generally, it is to be hoped that the illegal and arbitrary "B.W.G." will then cease to be specified by purchasers.

An admirable "Report on Radiation and the Quantum Theory," by Mr. J. H. Jeans, has been published by the Physical Society of London. It contains an introductory portion showing in simple language the need for a quantum theory, followed by a general discussion of the radiation problem on the lines of the classical mechanics, an account of the development of the quantum theory, and special chapters on line spectra, photo-electric effects, and specific heat. The need for some theory not based upon Newtonian mechanics is shown by the fact that in all known media there is a tendency for the energy of any systems moving in the medium to be transferred to the medium, and ultimately to be found in the shortest vibrations of which the medium is capable. Thus, a system of corks connected by springs, and floating in a tank of water, will transfer any vibrational energy they have to water-waves, and ultimately to molecular heat. This tendency, which results from Newtonian mechanics, is not observed in the phenomena of radiation. Otherwise a hot body in a perfectly reflecting enclosure would transfer all its heat to the æther within the enclosure. Max Planck got over this difficulty by supposing that radiant energy is not emitted until it has reached a certain minimum quantity or "quantum." However difficult it may be to imagine such a process, Mr. Jeans agrees with the late Henri Poincaré that some such discontinuity in the structure of energy is imperatively required by experimental evidence.

The June issue of the Memoirs of the Manchester Literary and Philosophical Society contains seven memoirs, and extends to 140 pages. The whole of the memoirs have been issued separately by the society during April and May at intervals subsequent to their reception which vary from one to four months, the average being about two and a half months. This average does not differ much from that which obtains in the Royal Society of London and other societies. The various memoirs cover a wide range of subjects. One by Mr. R. F. Gwyther introduces a new specification of stress from which a great simplification of treatment results. Another by Mr. W. Cramp describes measurements of the flow of air through pipes, but ignores the work published by the National Physical Laboratory on the subject during the last four years. Mr. A. D. Hall, in a third memoir, shows how the old view that the plant derives nutrition direct from fertilisers in the soil represents the facts better than the newer one of Messrs. Whitney and Cameron, according to which all soils give a soil solution of the same composition from which the plant derives its nutrition and into which it excretes substances toxic to its kind. Two memoirs by Messrs. T. A. Coward and W. M. Tattersall are devoted to a valuable survey of the fauna of Rostherne Mere, a secluded fresh-water lake in the north of Cheshire. These remarks suffice to show that the society maintains a high standard in its memoirs.

In a paper read before the Tokyo Physico-Mathematical Society in April, which appears in the June number of the Science Reports of the Tohoku University, Prof. K. Honda puts forward a new theory of magnetism which appears to follow the experimental facts more closely than any previous theory. It is based on the following assumptions. The molecules, or in a solid, the molecular groups, which are in thermal agitation, have magnetic moments which are functions of the temperature. Their action on each other is due partly to actual impacts, partly to the magnetic field each sets up in its neighbourhood. In general the second effect is small compared with the first. When an external field is applied, both the impacts and the molecular fields tend to oppose the rotation of the magnetic axes of the molecules or molecular groups into line with the field. If the molecules or groups are elongated in shape the impacts almost entirely prevent rotation and the substance is paramagnetic. If the molecules or groups are spherical the impacts have only a small effect, rotation is resisted mainly by the mutual magnetic actions and the substance is ferromagnetic. Diamagnetism he considers to be atomic in nature and only another aspect of the Zeeman effect.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—The following is the ephemeris for Delavan's comet (1913*f*) for the current week (*Astronomische Nachrichten*, No. 4739):—

	R.A. (true) h. m. s.	Dec. (true) ° ′ ″	Mag.
Aug. 6 ...	6 21 19·9	... +40 40 17·9	
7 ...	24 46·8	... 41 0 47·7	... 6·1
8 ...	28 18·3	... 41 21 20·0	
9 ...	31 54·4	... 41 41 53·7	
10 ...	35 35·7	... 42 2 28·0	
11 ...	39 21·8	... 42 23 1·9	... 5·9
12 ...	43 13·2	... 42 43 34·5	
13 ...	6 47 10·0	... +43 4 4·6	

The current number of the *Observatory* (August) states that this comet was detected by Mr. W. H. Steavenson on July 4 at an altitude of 1°. It was of about the 6th magnitude, had a nucleus of magnitude 7·5, and a head of five minutes in diameter; daylight prevented the tail from being observed. It is expected that the object will be visible to the naked eye in September and October, but no more confident prediction than this can now be made.

NEBULAR ROTATION.—In this column on June 4 (vol. xciii., p. 361) reference was made to an announcement by Prof. Lowell of the discovery, by spectroscopic means, of the rotation of the Virgo Nebula. Dr. V. M. Slipher now publishes (Lowell Observatory Bulletin, No. 62) a brief communication describing in more detail the discovery in question. It seems that about a year ago a spectrogram of the Virgo Nebula N.G.C. 4594 showed the nebula lines to be inclined. A second plate verified the above, but was not considered sufficiently satisfactory to warrant a public announcement of the discovery. A recent photograph confirms the previous deduction, and it is stated that the inclination of the lines, which is analogous to that produced by the diurnal rotation of a planet, "is unmistakable, and leads one directly to the conclusion that the nebula is rotating about an axis." This nebula has a radial velocity of fully a thousand kilometres a second. The nebula is of a "spindle" type, and the slit of the spectroscope was placed over the long axis: these nebulæ are thus spirals seen edgewise, as previous observations of their form have led one to believe. The fact is now proved. Dr. Slipher promises the details of the observations in a general discussion of the spectrographic observations of nebulæ made since 1912. Some of the numerous spectrograms of nebulæ taken at Flagstaff have shown indications of inclined lines, among them being the great nebula in Andromeda, and he hopes to give a definite answer to the important question of the rotation of this the greatest of spiral nebulæ.

SOLAR PHYSICS OBSERVATORY, CAMBRIDGE.—The first annual report of the director of the Solar Physics Observatory, Cambridge, to the Solar Physics Committee covers the year commencing April 1, 1913. The introductory remarks contain a statement indicating the circumstances in which the observatory is now administered, and deplore the loss of three members of the committee, namely, Sir George Darwin, Sir Robert Ball, and Sir David Gill, since the appointment of the committee in June, 1912. After a reference to the purchase of additional land extending down to the Madingley Road and to the selection of instruments to be used, the new buildings are next described. These include an extensive and complete laboratory building forming an extension at the west end of the astrophysical building, a spectroheliograph house, a dome 27 ft. in diameter for the 3-ft. reflector, etc. The energies of the staff are stated to have been chiefly confined to getting the observatory into working order, and for this reason systematic work not involving fresh observations was undertaken, and night work put somewhat in abeyance. Under the heading "Stellar Work," the photographic and visual observations made with the Newall telescope are recorded. These consist of spectrograms of variable stars and visual observations of the spectra of fine novæ. A discussion of spectrograms of Nova Persei No. 2 has been completed, and an atlas of typical stellar spectra with assigned chemical origins of the lines is in course of preparation. Under the heading, "Solar Work," that with the spectroheliograph and the McClean solar instruments is dealt with, while in meteorological physics a brief account is given of the investigations in atmospheric electricity and experimental work on ionising radiations. Preparations were made for the observations of the coming eclipse of the sun, the director and two members of the staff planning to take up their station near Feodosia in the Crimea.

ANNALS OF THE ROYAL BELGIUM OBSERVATORY.—The second part of vol. xiii. of the Annals of the Royal Observatory of Belgium contains three separate memoirs. The first is confined to the details of observations of variable stars made at that observatory during the period 1907 to 1912 by Messrs. G. van Biesbroeck and L. Casteels. Forty-six stars are here studied and the total number of observations published is 3225. Chief attention has been paid to new variables which have not been well studied. In many cases their identity was so ambiguous that the authors have studied the stars themselves, and for the sake of future observers have published charts of the regions where those stars were not included in the Bonner *Durchmusterung*. In many cases light curves accompany the text. The second portion of the volume brings together the observations made with the 38 cm. aperture equatorial by Dr. G. van Biesbroeck during the period 1907 to 1912; these comprise the observations of double stars, comets, minor planets, and phenomena. The third and last portion, by M. L. Casteels, summarises the physical observations of comets made by him in the years 1910 and 1911. Both the second and third portions are accompanied by numerous illustrations of the details observed in comets' heads.

THE ABERDEEN MEETING OF THE BRITISH MEDICAL ASSOCIATION.

AT the meeting of the British Medical Association held in Aberdeen during the last week of July, the presidential address was delivered by Prof. Sir Alexander Ogston, the distinguished surgeon, whose classical reseaches on the organisms of suppuration constitute a landmark in the history of bacteriology in this country. Prof. Ogston described the foundation in Aberdeen of the first medical school in the United Kingdom, and paid a tribute to the sagacity of Bishop Elphinstone, who in planning the university provided for a faculty of medicine.

The sectional addresses were of the usual character, surveys of progress in the various departments of medical and surgical science.

To the proceedings of the various sections several interesting contributions were made. In the course of a discussion on the cause of death under chloroform, Prof. MacWilliam stated that so long ago as 1887 he had pointed out that the cause of sudden cardiac failure under chloroform was due to ventricular fibrillation. With continuous administration of chloroform there was no danger of fibrillation and sudden collapse, but with intermittent administration the case was otherwise. Fibrillation was due to sudden increase of chloroform vapour during the sensitive stage. Omnipon and choral previously administered gave no protection. Dilatation of the heart was not protective. With normal and increased vagus control, fibrillation is prevented. Removal of vagus control is apt to lead to fibrillation, afferent impulses then constituting a danger. The acapnia hypothesis of Henderson did not meet the facts.

During the discussion on the pathology of heart function Dr. Lewis brought forward evidence to prove that fibrillation was due to independent action of the muscular fibres of the heart. In the case of heartbeats, either in response to normal physiological impulses or in response to a weak faradic current, if two pairs of contacts were placed on the heart one above the other and in close proximity to each other, string galvanometer curves taken during the contraction of the cardiac muscle from both pairs gave electrocardiograms of similar pattern. But in auricular or ventricular fibrillation tracings from the same leads showed no similarity of pattern. Consequently he concluded that in fibrillation the adjacent muscle fibres were acting independently of each other.

Dr. Ivy Mackenzie, discussing the anatomy of the primitive specialised cardiac tissue in birds, pointed out that there was no sino-auricular node and no auriculo-ventricular bundle similar to the Bundle of His.

A muscular connection between auricle and ventricle did exist on the right side of the heart near the coronary sinus. In the heart of the guillemot a node of specialised tissue could be demonstrated at the junction of the inferior vena cava and right auricle.

During a discussion on carbohydrate metabolism, Dr. MacLean demonstrated a valuable method of accurately and quickly estimating the amount of sugar in about 2 c.c. of blood.

Prof. MacLeod (Cleveiand), discussing the glycogenic function of the liver, stated that although the Claude Bernard doctrine regarding the fate of the glycogen stores of the liver no doubt holds true for strictly physiological conditions, this was not the case in certain experimental conditions such as hydrazine and phosphorous poisoning. Evidence was brought forward to show that even in the typical forms of hyperglycogenolysis much of the glycogen also becomes discharged into the blood of the hepatic veins as a colloidal (dextrinous) body and in the condition of local asphyxia of the liver as lactic acid. The lactic acid content of the blood leaving the liver was assayed by the method of von Fürth and Charnass.

Dr. Cathcart gave a short communication of much interest on the *rôle* of carbohydrate in nutrition. He pointed out that it was no longer possible simply to assess the value of a diet on its caloric content. It had, of course, always been admitted that there must be a sufficiency of protein present, but it was generally believed that fats and carbohydrates were mutually replaceable in isodynamic amounts. Dr. Cathcart stated, as regard carbohydrate, it might be accepted as an established fact that a certain proportion of this material must be present in a diet. In support of this he gave an account of a series of experiments in which the degree of protein catabolism was investigated on diet consisting of olive oil and varying amounts of pure glucose. He maintained that his results showed conclusively that although carbohydrates and fats were mutually replaceable to a certain extent, this replacement could not be carried out to the complete exclusion of carbohydrate.

In the neurological section Dr. James McIntosh pointed out that the failure of antisyphilitic remedies to influence the conditions known as parenchymatous syphilis was due to their not being able to pass through the capillaries of the brain to the nerve substance proper. The cerebro-spinal fluid was not the lymph of the brain, and these remedies did not reach the brain by this channel, as had been suggested. He had failed to find any improvement in cases treated by intrathecal injections of salvarsanised serum or of neosalvarsan, and did not believe this newer method would have any permanent vogue.

In the bacteriological section, Drs. Hort and Ingram discussed the cocco-bacillus they had recently isolated from typhus patients, which on injection into the Bonnet monkey in several cases produces a high continued fever after an incubation period.

THE HAVRE MEETING OF THE FRENCH ASSOCIATION.

THE forty-third congress of the French Association for the Advancement of the Sciences, which has just been held at Le Havre, was noteworthy for the invitations extended by that association (1) to those members of the British Association who did not attend the Australian meeting, (2) to the delegates of the Corresponding Societies of the British Association. Both invitations were accepted by a number of English visitors, who were accorded a very hospitable reception. At the opening meeting of the congress, held in the Havre Theatre. "God save the King" was played by the orchestra, the whole assembly rising in honour of the English national anthem. M. Armand Gautier presided, and (after speeches of welcome had been delivered by M. Morgand, the maire of Havre, and M. Jules Siegfried) called upon Sir William Ramsay, as the principal delegate of the British Association, to address the meeting. This he did in a discourse which was felt to be charming and sympathetic. He referred to the community of races between the French and the English, to the ninety-nine years of peace that have subsisted between the two nations, and to the illustrious men of science that each has produced, associating the immortal names of Pasteur and of Lister, both of whom had saved more lives than the most sanguinary of wars had destroyed. M. Gautier then delivered his presidential address, in which he referred to recent studies in hydrology and oceanography, with especial reference to their bearing upon the welfare of the town in which the meeting was held, and spoke eloquently of the sea as contributing to the grandeur of the countries which it washes and to the heroism of their inhabitants. The annual report of the association was then read by Dr. Loir on behalf of the secretary, and gave evidence of good scientific work in various directions and of a sound financial condition. In the evening a reception was given by the municipality in the Hôtel de Ville.

On Tuesday morning a prehistoric exhibition was opened in an annexe of the Museum of Natural History. It comprised a selection of false antiquities, a large collection of palæolithic implements found in the bed of the Seine, at Le Havre, and a well-classified collection of neolithic objects. The other contents of the Natural History Museum were described by Dr. Loir, the curator.

At the meeting of the Conference of British Delegates of Corresponding Societies which, by the courtesy of the French Association, was made part of the proceedings of the Congress, and was held in the Salle des Conférences of the Hôtel de Ville, the chairman expressed the gratitude of the delegates to the Association for the compliment thus paid to them. The absence of Sir George Fordham, who had been nominated President of the Congress, was a disappointment, but it was, to some extent, made up for by his having sent the MS. of his presidential address, which was read. It comprised an interesting account of the origin of these conferences, in which Mr. John Hopkinson was the principal actor, and which have now been held for more than thirty years. The number of corresponding societies and of delegates has continuously increased, and the papers read at the conferences, the annual reports of the Corresponding Societies Committee, and especially the annual lists of papers read before local societies have been of great value; but Sir Geoge Fordham was of opinion that the advantages proposed by these annual conferences had not been fully realised, and attributed it, to some extent, to a want of interest in their work on the part of the secretaries of some societies, an evil for which he was unable to suggest a remedy. A similar opinion was expressed by Dr. Garson, but Dr. Bather and Mr. Hopkinson entertained a different view. A paper was then read by Mr. John Hopkinson on local natural history societies and their publications. He restricted his observations to those societies which were formed for the definite and practical purpose of investigating the natural history of the locality in which they are formed. He urged upon such societies the necessity of division of labour, one member acting as meteorological recorder, another as geological recorder, another as recorder of birds, and so forth, after the plan adopted by the Hertfordshire Natural History Society, of which Mr. Hopkinson is the secretary. For members who are not workers, popular lectures should be provided. He considered the subject of the publications of the societies entirely from the point of view of a bibliographer. On this he had many practical suggestions to make. Especially he urged that the papers printed should be those giving the results of original work, and he gave further examples from the publications of existing societies of the way in which this should be done, and emphasised the importance of accurately dating every publication. Dr. Loir approved of Mr. Hopkinson's recommendations generally, but said that if they were constituted into rules, the system would not go down with French societies, who were too solicitous of their independence to agree to work on a uniform system. The subject was afterwards further considered at a conference over which M. Ray presided, on the organisation of French societies.

Besides the prehistoric exhibition, a retrospective marine exposition, and expositions of medical electricity and of odontology were organised by the sections respectively concerned.

The French Association has not the same dread of a multiplicity of sections that we entertain in England, inasmuch as the number of separate sections was not fewer than twenty. It is impossible in so short a notice as this to do justice to the work undertaken by all of them, but a few of the subjects dealt with may be noted.

The questions submitted to the section of anthropology, over which Prof. Gidon, of Caen, presided, related entirely to Normandy, and dealt with its ethnography, its prehistoric deposits, its megaliths, and the recent discoveries in its prehistory. A subsection of this section was devoted to history and archæology, under the presidency of Dr. Leroy, of Le Havre. Here were discussed the Roman roads, their points of termination on the Norman coasts, and their relation with England, the Roman camps of the valley of the Seine, the Norman influences on the architecture of England, the appearance and development of statuary in Normandy, and other like subjects.

The section of political economy and statistics, of which M. Granet was president, considered the utility of commercial agents to the foreigner, the increase in the cost of living, and a *projet de loi* upon the unification of measurements.

Prof. Ray was president of the section of pedagogy and instruction, where were to be discussed the questions of after-study, of the place of the Press in popular instruction and education, of the utilisation of museums in all branches of education, and of the educative value of the constitution of a conference of affiliated societies in connection with the French Association.

The French Association, like the British, has had to create a special section for agronomy, and this was presided over by M. de Coninck. It considered many questions of breeding, agricultural industry, rural economy, and agricultural engineering.

As in England, the great subject of physics, comprising mathematics, astronomy, geodesy, and mechanics, in respect of which two sections had been combined into one, asserted its pre-eminence, and M. Mesny, director of the School of Hydrography of the Navy, presided over both. Naturally, the subject of naval construction was one of those considered, and others were the history of the calculating machine and its possibilities, and the biography of those mathematicians whose careers have shed lustre on the departments of the Seine Inférieure.

Two sections were also combined to deal with the sciences of navigation, aeronautics, and civil and military engineering. To these a large number and variety of questions were submitted, including maritime fishery, the stabilisation of aeroplanes, canal transit, wireless telegraphy, and other problems of the day. M. Gobin was the president of the combined sections.

The section of meteorology and terrestrial physics was presided over by M. Georges Lemoine, of the Institute. It considered maritime meteorology, surface winds, and the local meteorology of the department.

The section of geology and mineralogy had for president M. Bigot, dean of the Faculty of Sciences, and the questions submitted to it related almost wholly to the geology of the district in which the meeting was held.

The section of medical sciences, presided over by Dr. Paul Engelbach, of Le Havre, also devoted itself largely to local problems, but it also took into consideration alcoholism, the transfusion of blood, antityphoid vaccination, and leprosy. Other medical sections were those of pharmacological science, medical electricity, odontology, chemistry, hygiene, and public medicine.

The geographical section, of which M. Dupont was president, had on its programme the subjects of the Panama Canal, the Channel Tunnel, and many matters of more local interest.

The French Association may well be congratulated on its Havre meeting.

IMPERIAL CANCER RESEARCH FUND.

THE annual meeting of the general committee of the Imperial Cancer Research Fund was held on July 21, the Duke of Bedford, K.G., president, in the chair. Among those present were Sir R. Douglas Powell, Sir Thomas Barlow, Sir Rickman Godlee, Sir William Church, Sir W. Watson Cheyne, Sir John Tweedy, and Prof. Sims Woodhead.

Dr. Bashford's report stated that during the past year fewer claims to the possession of a cure for cancer had been brought to the notice of the fund. In no instance was the information of a kind to necessitate further inquiry. None of the alleged remedies were new, all having been brought to notice in one form or another in earlier years.

The Two Categories of Transplanted Tumours.

As a result of the work carried out in the laboratory, it was becoming more and more generally recognised that transplanted tumours fell into two main categories, namely, a very small group which grew progressively because they did not produce resistance to their own growth, and a large group in which the tumours tended to disappear spontaneously in varying proportions because of the resistance to their growth, which was induced in the body as a result of their presence; indeed, in extreme cases, every animal, as it were, cured itself. The claims to cure cancer in mice had without exception been made by investigators who had not recognised the latter fact with regard to the propagation of tumours, and who had been dealing with the latter class of tumours not supplied from the laboratory of the fund. The Imperial Cancer Research Laboratories had distributed widely a tumour-strain of the former class which grew progressively in all animals and produced metastases, and these were the tumours which ought to be employed for the purposes of therapeutic experiments; up to date no successful results had been obtained with them. It seemed well to emphasise these facts because most, if not all, the transplantable tumours in the possession of other investigators did not fully reproduce the natural features of cancer, and a large number of proprietary preparations, many of them metallic and possibly dangerous, were now on the market as cures for cancer, on the basis of these untrustworthy laboratory experiments.

Resistance to Growth.

Further investigations had been conducted into the nature of the resistance which, as previously reported, can be induced in animals so as to render them refractory to the growth of transplanted tumours. Advances of a purely technical character have permitted it to be demonstrated that resistant animals possess the power of destroying cancer-cells introduced into the blood-stream. The question of resistance to growth is of great etiological importance, because it has been shown that when tumours previously capable only of transitory growth acquire the power of progressive growth and of dissemination, the result is due to the loss of power to produce hindrance to their own growth.

Abderhalden's Serum Test.

Abderhalden claimed that the serum of cancer patients had the power of breaking down or digesting tumour tissue in a test-tube in a way that normal serum did not, and by a special technique a colour-reaction might be obtained which was held to be diagnostic of cancer. The technique had been improved, and it was now possible to avoid contradictory results. It appeared that reliance ought not to be placed on this reaction either in pregnancy or in the diagnosis of cancer.

Increase of Cancer in Certain Situations.

It was quite justifiable to make such a crude statement as that the number of deaths assigned to cancer had increased in 1911 for females to 1088 a million living in 1911, as compared with 500 in 1860; and for males to 891 from 200 during the same period. It was also justifiable to express these facts in another way (also crudely), namely, that of women attaining the age of thirty-five, 1 in 12 was recorded as dying of cancer in 1889, but 1 in 7·4 in 1911; and of men 1 in 21 in 1889, but 1 in 9·7 in 1911. But these figures ought not to be set out, as they still were, before the public without any qualification, and interpreted forthwith as a demonstration of the reality of the increase of cancer. The increase in the number of deaths was not uniform for the different parts of the body, and for some parts, notably the uterus, an actual fall was persistently evident since 1902.

Heredity.

There were still no trustworthy data available as regards cancer in man. In mice hereditary predisposition had been shown to exist, sufficient to double the incidence of cancer in female mice in the ancestry of which cancer had occurred not further back than the grandmother, as compared with animals in which the cancerous ancestry was more remote.

Cancer Areas and Cancer Houses.

The question of cancer houses had been allowed to stand over until experiment and the improvement in the collection and tabulation of statistics had advanced to a point which made it possible to discuss the subject on the basis of positive knowledge. With the awakening of interest in the study of cancer in animals, the belief in cancer houses was naturally transferred to "cancer cages," largely on the basis of statements made by breeders. The extensive experience of the Royal Prussian Institute for Experimental Therapeutics agreed with the even larger experience of the Imperial Cancer Research Fund under laboratory conditions. Cancer cages, in the sense that animals housed in them became infected, were a myth. Contact with animals with natural or inoculated cancer did not increase the liability to the development of the disease.

A considerable part of the report was devoted to the discussion of the question of "cancer houses." Five of the best known instances of cancer houses had been inquired into and the places visited. Inquiries had also been instituted into a sixth area, which had also been visited. The investigations into "cancer houses" and "cancer areas" accorded with what had been established by experiments on animals. "Cancer houses" were as much a myth as were "cancer cages."

INTERNATIONAL COMMISSION ON THE CHEMICAL ANALYSIS OF SOILS.

A MEETING of the International Commission on the Chemical Analysis of Soils was held at the Forestry Research Station, Munich, on April 23–24. Prof. Kraus, of the agricultural department of the Technical Highschool, Munich, was elected chairman.

The first discussion, on the "Preparation of Soil Extracts for Total Analysis," was opened by Dr. A. von Sigmond (Budapest), who had prepared an exhaustive account of previous discussions on the subject at earlier meetings of the commission. The account is published in the *Internationale Mitteilungen für Bodenkunde*, 1914, and includes, in addition to the opinions of von Sigmond himself, articles by Dr. D. J. Hissink, Wageningen; Prof. E. W. Hilgard, Berkeley, California; and Prof. E. A. Mitscherlich, Königsberg. The discussion centred round the relative merits of:—(1) *Hilgard's Method*, digestion of the soil for 120 hours with HCl of 1·115 sp. gr. on a water-bath; (2) *van Bemmelen's Method*, division of the soil into two parts according to their solubility in HCl and H_2SO_4; (3) *Ultimate Analysis* (*Bauschanalyse*) by fusion with alkali, or treatment with HF.

Hissink objected to Hilgard's use of 1·115 HCl, and produced a "boiling-point" curve for HCl of varying strength to show that Hilgard's acid could not have the maximum solvent action, but that it lay with a rather stronger acid which had a higher boiling point. He gave the following results:—

Sp. gr. of HCl		1·115	1·16	1·19
Dissolved	Al_2O_3	11·7	12·0	12·1
,,	Fe_2O_3	11·7	11·6	11·7
,,	SiO_2	25·1	25·6	25·3
,,	K_2O	1·56	1·51	1·52

and recommended van Bemmelen's method as being the most complete for soil constituents likely to become available for plant food.

Prof. A. Rindell (Helsingfors) gave results of estimations of K_2O in felspar using varying proportions of felspar to acid:—

Felspar gr./litre	K_2O gr./litre	Per cent. of K_2O
50	0·144	0·288
100	0·258	0·258
200	0·511	0·256
300	1·034	0·207

He recommended the "ultimate analysis" as the only one likely to give comparable results for all soils.

Mitscherlich regards no method of strong acid extraction as valuable on the ground that the solution is affected by too many variables.

The position was summed up by Prof. Ramann (Munich), who spoke in favour of much quicker methods, *i.e.* a shorter digestion with HCl, designed not to give a full analysis of all soil constituents, but of the more easily decomposable substances which may within a relatively short period become available as plant food. He contended that such analyses taken in conjunction with others, such as the estimation of easily soluble constituents, the mechanical analysis, etc., would for all soils of the same type give accurately comparable results.

The members of the commission finally decided to unite in their efforts to obtain a standard method, and to investigate thoroughly the different methods side by side for their particular types of soils.

The next discussion, led by Mitscherlich and Ramann, dealt with the "Estimation of the Easily Soluble Soil Constituents." Mitscherlich advocated his well-known method of extraction with water saturated with CO_2, the temperature, time of extraction, quantities of water used, etc., all being constant during the extraction and for all soils. Ramann outlined a new and interesting method recently tried by him, but not yet thoroughly worked out in detail.

The water-containing double silicates of the soil can be separated into two groups: (1) those which permit of a quick, almost instantaneous replacement of their bases; (2) those with which the replacement of their bases takes place only very slowly. The bases from group (1) can be completely removed from a soil by the action of a fairly strong (10 per cent.) solution of an electrolyte, provided that the experiment is so arranged, that the soil is continually in contact with the fresh solution, or, in other words, that the dissolved bases are immediately removed. This is carried out by allowing the electrolyte solution to filter slowly through a column of soil in a vertical glass tube. Ramann found that by taking 25 grams of soil and a 10 per cent. solution of ammonium nitrate the whole of the easily replaceable bases of group (1) was contained in the first 50 c.c. of the filtrate. The following quantities of 50 c.c. contain a very small proportion of replaced bases, the quantity of which represents the equilibrium between electrolyte solution and the silicates of group (2). For example, the proportions of CaO, MgO, K_2O, Na_2O obtained in the first, second, third, fourth, and fifth 50 c.c. of filtrate for 25 grams of soil were as follows:—

Order of filtrate (50 c.c. to each)	1st	2nd	3rd	4th	5th
CaO	0·403	0·029	0·049	0·042	0·030
MgO	0·076	0·002	0·009	0·008	0·004
K_2O	0·013	0·002	0·004	0·002	0·003
Na_2O	0·012	0·003	0·005	0·003	0·002

Ramann is of the opinion that these easily replaceable bases represent the bulk of the available mineral matter in soils, and therefore proposes that this should be estimated.

To obtain further information as to the bases in soils most easily attacked and set free by weak acids, and as to the easily soluble P_2O_5, Ramann makes use of water containing CO_2. The extraction is carried out in a large Soxhlet extractor; the water is boiled and condensed in the usual way, and the CO_2 is led directly into the thimble containing the soil. The stream of CO_2 is constant, the temperature is kept as constant as possible (between 60° and 70° C.), and the burner arranged so that the syphon works every 90 minutes. The extraction continues for ten hours, when practically all solvent action has ceased. Ramann recommends that the two estimations should be made simultaneously.

These methods called forth such universal interest that practically all members took part in the discussion following, and unanimously requested a demonstration of the methods, which was given at the end of the conference in Ramann's laboratory. The remarkable part of the discussion was that no method involving the use of organic acids, such as citric acid, was even mentioned. The methods of Hall and Dyer, and the American official method, used almost exclusively in England and America respectively, appear to be very little used on the Continent.

It was unanimously decided that for the purposes of the commission, *i.e.* the arrangement of standard international methods of soil analysis, members should for the present confine their work to extractions with water and CO_2.

The discussion on methods for the "Estimation of Acidity in Soils" was opened by Dr. Gully, of the Research Station for Moor Cultivation in Munich. He gave an account of the methods tried in his laboratory for the estimation of acidity in peats from different types of moors. The most satisfactory results were obtained by treatment of the peat with calcium acetate and estimation of the free acid resulting.

Dr. Tacke (Bremen) supported the method adopted at Bremen, *i.e.* neutralisation with $CaCO_3$, on the ground that it involves the actual practical method of getting rid of acidity in moors. Moreover, whether the acid properties are due to the presence of actual acids or to colloids, $CaCO_3$ is the best and most commonly applied neutraliser.

Tacke's method found many supporters who frequently use it and have always found it efficient. Results obtained at Bremen with the two methods, $CaCO_3$ and calcium acetate, agreed very well. It became at once noticeable that the former diversity of opinions between the stations at Bremen and Munich, as to the nature of soil acidity, no longer exists to the same extent. It appears to be generally accepted that the acidity of sour soils may be due to the presence of both actual acids and colloids. Tacke still maintains that the fact that most colloids present in soils are acid is sufficient to account for the views previously put forward by Baumann and Gully.

The discussion was chiefly remarkable for bringing out the large number of methods which have been employed by different workers. These included the direct method of obtaining an alkali extract, precipitating the brown colloidal matter with neutral calcium chloride, and titrating the clear solution. Another method was the estimation of the H ions in a water extract. It was considered that much more research is required before any particular method can be adopted officially.

A committee, consisting of Prof. Albert, Prof. Rindell, Dr. Tacke, and Dr. Gully was appointed to test thoroughly the different methods.

After the meeting the members of the commission were conducted by Prof. Kraus through an interesting collection of soils in his laboratory, including typical agricultural soils of Bavaria and other German States and also a large collection from the German colony of Togo; then by Prof. Henkel through the other laboratories of the agricultural section of the Munich Technical High School.

J. A. H.

THE STARS AROUND THE NORTH POLE.[1]

THIS is a mathematical problem which can be solved fairly easily, and the answer is that the stars must be distributed in distance according to a law shown graphically by the curve in Fig. IV. (The distribution of velocities $\frac{h}{\sqrt{\pi}}e^{-h^2v^2}dv$ combined with the distribution of proper motions $\frac{d\tau}{a}\left(1+\frac{\tau^2}{a^2}\right)^{-\frac{3}{2}}$ leads to the patial distribution $2a^2h^2re^{-a^2h^2r^2}dr$).

In the diagram, distances are measured horizontally, the unit of distance being that at which a star's parallax is equal to 1″ (or 206,265 times the distance of the earth from the sun). It is convenient to have a name for this unit, and in what follows the word *Parsec*, suggested by Prof. Turner, will be adopted. With this unit a distance of 100 in the diagram denotes twenty million times the distance of the sun from the earth. The following table gives the percentage of stars between certain limits of distance:—

TABLE IV.

6 per cent. of the stars are between	0	and	100	parsecs
5 ,, ,, ,,	100	,,	200	,,
10 ,, ,, ,,	200	,,	400	,,
43 ,, ,, ,,	400	,,	700	,,
36 ,, ,, ,,			>700	,,

It follows that 88 per cent. of the stars in Carrington's Catalogue—that is, 88 per cent. of all the stars brighter than about 10·5 magnitude—lie between 20 and 150 million times the distance of the sun from the earth. This law of the distribution of the stars is at first sight rather surprising. It should be remembered that the only stars at a great distance which are included are those which are intrinsically very bright, and these form only a small proportion of all the stars. Prof. Eddington has found that a similar law holds for stars brighter than 6·0 magnitude.

Having found the law of distribution of the distances of these stars, it is not difficult to determine something about their absolute luminosities, *i.e.* how they would compare with the sun in brightness if placed at an equal distance from us.

If the sun were at a distance of one *parsec*, it would appear as a bright star, brighter than the first magnitude—actually of magnitude 0·5; if at a distance of 100 parsecs, its magnitude would be 10·5. Now all the stars in Carrington's Catalogue may be taken as brighter than 10·5 magnitude, thus at least 95 per cent. of these stars are intrinsically brighter than the sun, and at least 80 per cent. are four times as bright, 40 per cent. are sixteen times as bright, and 8 per cent. are fifty times as bright.

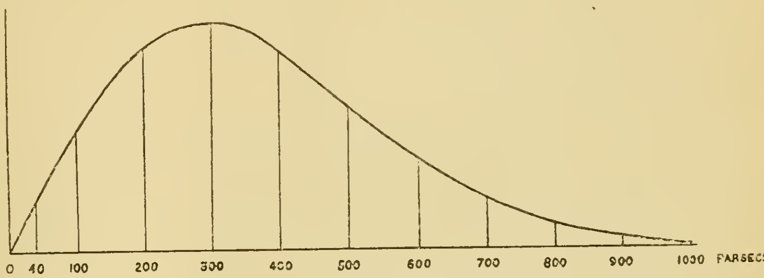

FIG. 4.—Distribution in distance of the stars in Carrington's Catalogue.

We may conclude that the great majority of the stars brighter than 10·5 magnitude are intrinsically brighter than the sun, and a considerable proportion very much brighter.

The distribution of bright and faint stars in a given volume of space is quite different, and contains a much larger proportion of faint stars. If we make the assumptions that the density of the stars and the proportions of bright and faint ones is the same at the different distances from the sun within which these Carrington stars are situated, it is possible to find the actual number of stars of different luminosities in a given volume of space. In a sphere with radius 100 parsecs, or twenty million times the distance of the earth from the sun, there are, at least,

24	which are	100	times as luminous as the sun		
340	,,	50	,,	,,	,,
1,530	,,	25	,,	,,	,,
4,840	,,	10	,,	,,	,,
23,200	,,	1	,,	,,	,,
93,300	,,	$\frac{1}{10}$th the luminosity of the sun.			

[1] Discourse delivered at the Royal Institution on Friday, April 24, by Dr. F. W. Dyson, F.R.S. Continued from p. 576.

The data only admit of a rough determination of the number of very faint stars and the number of very bright ones. The figures give a general indication of the density of the stars in space and of their intrinsic brightness, and serve to direct attention to the fact that there are many stars much less luminous than the sun, and a certain proportion very much more luminous.

The conclusions drawn up to this point have been based entirely on a consideration of the proper motions of the stars, irrespective of whether they are bright or faint, provided only that they are sufficiently bright to have been observed by Carrington. But as the apparent magnitude of a star depends on its distance as well as on its intrinsic brightness, we naturally expect some assistance in assigning the distances of these stars from their magnitudes. The brightest star in this small area round the North Pole is Polaris, the magnitude of which is 2. (It may be remarked incidentally that the distance of the pole star has been actually measured. It is twenty parsecs, or four million times the distance of the sun from the earth, and if it were at the same distance as the sun it would appear to be 100 times as bright.) Then there are about twenty stars which are visible to the naked eye. The following table gives the actual number of stars of different magnitudes (photographic):—

TABLE V.

Brighter than	7·0m.	61 stars
From 7·0m. to	8·0m.	124 „
„ 8·0m. „	9·0m.	397 „
„ 9·0m. „	10·0m.	998 „
Fainter than	10·0m.	2140 „

Then, again, the stars may be divided into groups according to the physical characteristics revealed by the spectroscope. The researches of Kapteyn, Campbell, and others have shown—at any rate, for the brighter stars—remarkable relationships between the distances and velocities of the stars and the type of spectrum which they manifest. It is therefore desirable to examine the proper motions of stars of different spectral types separately. The spectra of many thousands of stars have been determined at Harvard College, under Prof. Pickering's direction, by Miss Cannon. The different classes are indicated in the Harvard classification by the letters B, A, F, G, K, M, with further subdivisions. The B stars are characterised by the presence of helium, the A stars by series of broad hydrogen lines. In the F stars the hydrogen lines are thinner, and fine metallic lines are shown. The G stars are very like the sun, full of metallic lines, and with broad lines due to calcium. In the K stars the two calcium lines are still broader, and there are many fine metallic lines. The M stars are characterised by broad absorption bands. This arrangement places the stars in the order of their temperatures; the B stars are the bluest and hottest, and the M stars the reddest and coolest. The character of the spectra of about 800 of the stars in Carrington's Catalogue is given by the Harvard observations.

For the fainter stars the spectra have not been determined, but they can be inferred in another way. As the blue stars are more active photographically than the red stars, if a red and a blue star have the same visual magnitude, the magnitudes estimated from the images on a photograph will differ considerably, and this difference is an index of the colour, and thus of the type of spectrum. Now the visual magnitudes of most of these faint stars have been very accurately determined at Potsdam by Messrs. Müller and Kron (and have been kindly communicated in manuscript), and the photographic magnitudes have been determined at Greenwich. The differences have been taken between the photographic and visual magnitudes, and serve to classify the stars according to their temperature.

Separating the stars into two groups, those which are brighter than 9·5 magnitude on the Potsdam scale of magnitudes, and those which are fainter than 9·5 magnitude, and dividing each group into four classes according to the colour index, the parallactic motion, *i.e.* the mean angular movement per century arising from the motion of the sun through space, is determined for each class. The results are exhibited in the following table:—

TABLE VI.

Spectral class	Colour index	Stars brighter than 9·5m. Number	Parallactic motion	Stars fainter than 9·5m. Number	Parallactic motion
			″		″
K—M	>8	175	0·65	269	0·36
G—K	4 to 8	168	1·31	428	0·95
F—G	− 1 to 4	264	2·58	959	1·53
A—F	< − 1	240	1·97	460	1·28

In this table the red stars are on the top line; the third line consists of stars which are in the same stage of development as the sun; those in the second line are somewhat cooler and redder; those in the last line hotter and bluer. The last line includes a few, but only a few, B stars, as there are not many in this part of the sky. The quantities in the fourth and six columns of the table are a gauge of the distance of the stars to which they refer. It is only necessary to divide these into 337″, which is the angle through which a star distant 1 parsec would have been displaced in the solar motion in one hundred years, to obtain the distances in parsecs. Thus the 240 stars belonging to types A–F, and brighter than 9·5 magnitude, are at an average distance of 170 parsecs.

The first point to notice is that parallactic motions of stars fainter than 9·5 magnitude are always considerably less than the corresponding quantities for stars brighter than 9·5 magnitude. This is, of course, because the faint stars are, on the whole, further away. The average distance of stars of magnitude 10·0 is approximately 1¾ times as great as for a star of 8·0 magnitude.

The next point is the very great distance of the red stars. The 269 faint red stars are very nearly 1000 parsecs away, or 200 million times as distant as the sun. At this great distance the sun would appear as of magnitude 15·5, but these stars vary in magnitude from 9·5 to 11·0, and are therefore intrinsically from 250 to 63 times as bright as the sun. Now it happens that among the stars nearest to the sun the distances of which have been actually measured there are several red stars, and these are all very much fainter than the sun. It has been suggested by Prof. Russell and Prof. Hertzsprung independently that the red stars are of two distinct classes, which they call the giants and the dwarfs, and that, in accordance with Sir Norman Lockyer's views, the giant red stars are in an early stage of evolution, and are increasing in temperature; while the dwarf stars are at the other end of the series, and are growing colder and darker.

Leaving the red stars, it is seen that the stars the colour indexes of which lie between −1 and +4 are nearer to us than the groups on either side of them. These stars are those the spectra of which are of the types F and G in the Harvard notation, and are the stars most like the sun. The mean distances of these stars is only 130 parsecs for the stars brighter than 9·5 magnitude, and 215 parsecs for the stars fainter than 9·5 magnitude. At this distance the sun would be of magnitude 12·1. It follows that these stars are, on the average, from two to eight times as bright as the sun. The A–F stars are a little, but not much, further away, the stars fainter than 9·5 magnitude being at an average distance of 263 parsecs. At this distance the sun would have a magnitude of 12·5, and these stars are from sixteen to four times as luminous as the sun.

It has been shown how the knowledge that the solar system is moving in a known direction with a velocity of 19·5 km. per second leads to a determination of the distances of groups of stars the angular movements of which are known. The hypothesis made is that in a number like one hundred or two hundred stars, the irregular angular movements due to the motions of the stars themselves neutralise one another on the average. But this is only the mean distance of the group, and some are much nearer and some much further. The distribution of the stars about this mean distance may be derived from the proper motions, if we know how the linear velocities are distributed. I shall apply this method to the group of stars which are like the sun in type of spectrum, and therefore, presumably, of like temperature and physical constitution.

Dividing these into three classes according to their magnitude, it is found that their parallactic motion due to the sun's movement, and their average motion in the perpendicular direction due to their own peculiar movements, are as follows:—

	No.	Parallactic motion	Av. cross motion	Ratio
All stars down to 11·om.	1247	1·92″	±1·67″	0·87
Stars brighter than 10·om.	470	2·50	±2·10	0·84
„ „ 9·om.	148	3·34	±2·90	0·87

In the last column is given the ratio of the average cross motion to the parallactic motion. The agreement of the numbers shows that the bright stars and the faint stars have the same average velocity. Taking the velocity of the sun as 19·5 km. a second, it follows that the average velocity of these stars in the direction perpendicular to the sun's motion is 13·7 km. a second.

We shall now make the assumption that some of these stars are moving faster than this velocity and some slower, just as errors of observation are distributed about a mean error. With a mean velocity of 13·7 km. a second, there will be in 1000 stars

231	with velocities 0 to 5 km/sec.
208	„ „ 5 „ 10
175	„ „ 10 „ 15
141	„ „ 15 „ 20
163	„ „ 20 „ 30
59	„ „ 30 „ 40
18	„ „ 40 „ 50
1	„ „ >50

If now the observed proper motions are arranged, it is found that the number less than any value τ can be represented satisfactorily by an algebraic formula $N\frac{\tau}{(\tau^2+a^2)^{\frac{1}{2}}}$, where N is the total number of stars and a is the mean value of τ. The following table shows the actual number of stars with proper motions between certain limits, compared with the number given by the formula:—

Table VII.

Limits of proper motion	No. of stars observed	No. given by formula	Difference
0″ to 1″ a century	427	429	−2
1 „ 2 „	346	337	+9
2 „ 4 „	324	332	−8
4 „ 7 „	105	103	+2
7 „ 10 „	25	22	+3
>10 „	20	19	+1

We may take it that the formula substantially represents the observed facts. With the proper motions distributed according to this formula, and the actual velocities distributed according to the law of errors, the distribution of the stars in distance can be determined, and it is found that these 1247 stars are distributed in space as shown in Table VIII.

Table VIII.—*Number of Solar Stars (Types F and G) at Different Distances.*

Distance (parsecs)	Out of total 1247 stars	Out of 470 stars brighter than 10·om.	Out of 148 stars brighter than 9·om.
<100	121	76	40
100—200	298	161	65
200—300	332	136	34
300—400	254	68	8
400—500	146	23	1
500—600	65	5	
600—700	23		
>700	5		

The most remarkable feature of this table is that 70 per cent. of the stars lie between the narrow limits of one hundred and four hundred parsecs.

I have treated the 470 stars which are brighter than 10·0 magnitude and the 148 brighter than 9·0 magnitude in a similar manner. The results are given in the third and fourth columns of Table VIII. Taking the differences, the distribution in distance of the 777 stars of magnitude 10·0–11·0 and of the 322 stars of 9·0–10·0 magnitude is found.

To compare the intrinsic magnitudes of the stars it is convenient to take limits of distance in geometrical progression with a common ratio 1·259 (log = 0·1), *e.g.* 40, 50, 63, 79, 100, 126, etc., parsecs. These limits correspond to a change of half a magnitude in the intrinsic brightness of the stars which are of the same apparent brightness. Confining our attention to the stars of apparent magnitude 10·0 to 11·0, or, speaking broadly, stars of 10·5 magnitude, the limits 50–63 parsecs contain stars half a magnitude brighter, and distributed over twice the volume of those contained between the limits 40–50 parsecs.

If we may assume that the actual density of the stars is the same in all parts of the space with which we are dealing, we obtain by reasoning of this kind the number of stars between different limits of absolute brightness. The following table shows the number of stars of different luminosities in a sphere of one hundred parsecs radius:—

Luminosity ☉ = 1	No. of stars 10·om.—11·om.	9·om.—10·om.
0·40 to 1·0	16,000	18,000
1·0 „ 2·5	9,500	11,200
2·5 „ 6·3	5,750	7,300
6·3 „ 16	2,570	3,600
16 „ 40	502	1,040
Brighter than 40	14	68

The results in the second column have been obtained by considering the faintest stars, those from 10·0 to 11·0 magnitude. If the class brighter is taken, those stars which appear to be of magnitudes 9·0 to 10·0, we find in a similar way the quantities given in the last column.

There is an increasing divergence between the results. Now it is to be remembered that these figures have been derived from regions at different distances from the sun. Thus the stars which are between sixteen and forty times the brightness of the sun, and which are apparently of magnitude 10 to 11, lie between 398 and 631 parsecs, while those which are apparently of 9·0 to 10·0 magnitude lie between 251 and 398 parsecs.

We may conclude, therefore, that the density of this class of stars is somewhat less at this greater distance from the sun. Following out this line of reasoning, I have found that the diminution of density of the stars to be as follows:—

Distance	Density	Distance	Density
At 50 parsecs	1·30	At 300 parsecs	0·48
100 ,,	1·00	400 ,,	0·32
200 ,,	0·70	500 ,,	0·21

Although much weight cannot be attached to the exact figures, one seems justified in saying that there must be a very considerable falling off in the density of the stars between the distances of one hundred and five hundred parsecs. A falling off in the total density of the stars would affect the tables giving the proportion of stars of different brightness, and would increase considerably the proportion of bright stars.

Although the conclusions presented in this paper have been derived from a study of the proper motions of the stars in a small area of the sky, and may be somewhat modified by the investigation of other regions, they may be considered as fairly applicable to the stars in general. The limiting magnitude of the stars that have been considered is nearly 11·0 (on the Potsdam scale), and there are, in the whole sky, half a million stars brighter than this limit of magnitude.

It may be said of them that:—

(i) On the whole, the yellow stars, the stars like the sun in physical conditions, are the nearest.

(ii) They lie within fairly narrow limits of distance —80 per cent. are between one hundred and five hundred parsecs, 10 per cent. nearer than one hundred parsecs, and 10 per cent. further away than five hundred parsecs.

(iii) Going from the yellow to the blue or the orange stars, the average distances increase.

(iv) The red stars are at great distances—an average of about one thousand parsecs.

(v) The stars vary greatly in *intrinsic brightness*. The red stars are specially luminous, being on an average one hundred times as bright as the sun.

(vi) Considering all the stars down to this limit of magnitude, from 90 to 95 per cent. are intrinsically more luminous than the sun.

(vii) When, however, the luminosity of the stars in a given volume of space is considered, there are found to be far more faint than bright stars. There is no contradiction between this conclusion and the last one, because the more distant bright stars are visible, while we only see the faint ones which are comparatively near.

(viii) Evidence has been found that the stars thin out very materially at great distances from the sun.

These conclusions are in harmony with the conception of a finite stellar universe. Most of the stars we see, and a great many fainter ones, are within the distance of one thousand parsecs. Doubtless the stars extend to much greater distances, perhaps ten times as far or further, but we can scarcely doubt that we are near the middle of a finite group of stars, and that the extent of this group is of the order of one thousand to ten thousand parsecs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Two lectures on studies in historic magnetism will be given in the autumn by Prof. S. P. Thompson.

The Rogers prize has not been awarded this year. It will be again offered for award in 1916, and the subject of the essay or dissertation will again be "The Nature of Pyrexia and its Relation to Microorganisms."

Applications are invited from suitably qualified biologists wishing to engage in research work for the use of the University table at the laboratory of the Marine Biological Association at Plymouth. Preference will be given to members of the University of London. Applications should be sent to the secretary of the Board of Studies in Zoology, the University of London, South Kensington, S.W., and should be accompanied by a statement of the qualifications of the candidate and a brief account of the investigation which he proposes to undertake.

LONDON (UNIVERSITY COLLEGE).—The Drapers' Company has made a grant of 500*l*. a year for three years, in aid of the work of the department of applied statistics, including the Galton Laboratory of Eugenics and the Drapers' Biometric Laboratory.

THE Russian Imperial Duma has voted in favour of the proposal to establish a faculty of medicine in the University of St. Petersburg.

THE Hele-Shaw prizes in the faculty of engineering of the University of Bristol have been awarded as follows: to Mr. John Rogers (a day student) and Mr. Arthur George Adams (an evening student).

THE trustees of the University of Pennsylvania have sanctioned the admission of women to the medical college of the University. The new regulations will come into force in the autumn of the present year.

ACCORDING to a Reuter telegram honorary degrees have been conferred upon the following members of the British Association by the University of Perth, Western Australia:—Prof. W. Bateson, Prof. Herdman, Dr. A. D. Waller, and Dr. A. C. Haddon.

THE twenty-fifth anniversary of the opening of the Johns Hopkins Hospital will be celebrated in October next. The celebration will begin on October 5 with a meeting to be presided over by Dr. W. H. Welch, at which Prof. Sir William Osler will speak. On October 7 the new Brady Urological Institute will be dedicated.

THE Board of Education has issued [Cd. 7531] the regulations for technical schools, schools of art, and other forms of provision of further education in England and Wales which came into force on August 1. This year the Board has included in the same volume with the regulations for evening schools, day courses in technical institutions and schools of art, the regulations for junior technical schools and those for university tutorial classes. No changes of substance are made in the regulations for junior technical schools or in those for university tutorial classes. Other alterations, which are not numerous, are printed in distinctive type so as to make reference and comparison easy.

THE annual examinations of the National Agricultural Examination Board in the science and practice in dairying will be held for English students on September 12, and following days, at the University College and British Dairy Institute, Reading, and for Scottish students on September 19 and following days at the Dairy School, Kilmarnock. All candidates must have spent at least four months on a dairy farm, and present certificates from approved institutions testifying (1) that he or she has received at least six months' instruction in practical dairy work, and (2) that he or she has attended approved courses in chemistry, bacteriology, and botany, and has satisfied the authorities of the institution of his or her fitness for admission to the examination. Entry forms and all further particulars may be obtained from the Royal Agricultural Society of England, 16 Bedford Square, W.C., or the Highland and Agricultural Society of Scotland, 3 George IV. Bridge, Edinburgh. The latest date for receiving applications is August 15.

SIR J. J. THOMSON delivered the inaugural lecture at the summer meeting of the Cambridge Local Lectures on Friday last, taking as his subject, "Education and Science." Referring to the changes in the educational system, he said that visitors to Cambridge thirty or forty years ago used to get confused by the multitude of colleges, but the very small number of laboratories gave them no trouble. Now there were quite as many laboratories as colleges, and they would realise the liberality with which the ancient University had welcomed these modern studies. It had also made no distinction in its award of fellowships and scholarships between the old studies and the new, and had acted on the principle that its duty was to take all knowledge as its province. As one whose work had been for the most part connected with the newer studies, he was pleased to have the opportunity of acknowledging the liberality and sympathy which those studies had received at Cambridge. The progress of science had been hastened by the additional facilities provided for research in recent years. And if it was a fact that the application of science to the prevention and cure of disease, to the increase in facilities of transport, of intercourse, and of the amenities of life had been a gain to humanity, had increased human happiness, and diminished human suffering, then it was the bounden duty of every civilised nation or community to do all in its power to hasten that progress. Humanity was suffering from evils which could be cured more quickly if still greater resources were placed at the disposal of scientific workers. It would be unfair and ungrateful not to acknowledge that the Government, without any pressure from public opinion, had done something in that direction, but much remained to be done. When the people of this country realised that some of the evils from which they were suffering would be removed some day or other by science they would insist that the pace should be hastened as much as possible.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 20.—M. P. Appell in the chair.—Paul **Sabatier** and A. **Mailhe**: The catalytic decomposition of benzoic acid. A study of the action of various catalysts upon the vapour of benzoic acid at 550° C. With the blue oxides of tungsten and molybdenum and the oxides of zirconium and cerium the acid passes unchanged. Benzene and carbon dioxide are produced in presence of reduced copper, cadmium oxide, zinc oxide, and titanium oxide. Benzophenone is the main reaction product in presence of lithium and calcium carbonates.—H. **Douvillé**: The first geological epochs. A discussion of the composition of the earth's atmosphere at varying temperatures of the earth's crust, with especial reference to the conditions prevailing at temperatures between 700° C. and 364° C.—Y. **Delage**: The capture of a specimen of *Luvarus imperialis* on the coast of Finistère.—A. **Blondel**: Electric chronographs and self-recording micro-galvanometers. Remarks on an instrument recently described by M. Beauvais, and referring to earlier communications by the author describing a similar instrument.—Ph. A. **Guye** and F. E. E. **Germann**: The gases retained by iodine and by silver. An application of the apparatus recently described by the authors for the analysis of minute volumes of gas. The gas contained in the silver was determined by conversion into iodide in a vacuum, and the gases evolved pumped out and analysed. Oxygen, carbon monoxide, and water vapour were found.—Kr. **Birkeland**: The zodiacal light. A discussion of some recent observations from the point of view of the author's hypothesis, that the sun emits radiant matter and electrons, and that these corpuscles group themselves round the magnetic solar equator.—S. **Stoïlow**: The integrals of partial differential linear equations with two independent variables.—Pierre **Sève**: The use of an alternating current for the transmission of the indications of apparatus of which the index can effect complete rotations. Application to the distribution of time.—G. **Chaudron**: The reversible reactions of water on iron and on ferrous oxide. From the experiments quoted the author concludes that between 300° C. and 1000° C. there are two series of equilibria with the solid phases iron-ferrous oxide, iron-magnetic iron oxide.—M. **Delépine**: The separation of the optical isomerides of the iridotrioxalates.—F. **Taboury**: Contribution to the study of the iron-zinc alloys. The crystals formed in baths used for galvanising iron contain a constant proportion (7·3 per cent.) of zinc.—A. **Sénéchal**: The solid chromic sulphates.—H. **Giran**: Bromine hydrate. From a cryoscopic study of mixtures of bromine and water, Br_2+8H_2O is deduced as the composition of the hydrate.—Th. W. **Richards** and M. E. **Lembert**: The atomic weight of lead of radioactive origin. According to the theory of Soddy and Fajans, the atomic weight of lead derived from the decomposition of radium and uranium should be 206·0, that from thorium, 208·4, ordinary lead being 207·1. Experiments with lead from carnotite gave 206·59, from three samples of pitchblende, 206·57, 206·40, and 206·86, one from thorianite, 206·82.—A. **Desgrez** and R. **Moog**: A method for the estimation of urea. Details of a method based on the decomposition of urea by Millon's reagent, in presence of infusorial earth. Test figures showing the accuracy obtainable are given.—R. **Fosse**: The gravimetric quantitative analysis of small quantities of urea for dilutions greater than 0·1 per cent. The urea is weighed as an insoluble compound with xanthydrol.—H. **Gault**: Oxalocitric lactone and its transformation into tricarballylic acid. The best yield of tricarballylic acid from oxalocitric lactone is obtained by heating the latter with alcohol to 180° C.—Albert **Gascard**: The presence of an alcohol and an acid, both containing thirty-two atoms of carbon, in the wax of *Tachardia lacca*.—A. **Duffour**: An association of crystals of unequal symmetry.—C. **Gaudefroy**: The dehydration of gypsum.—J. **Deprat**: The projects for the Yun-nan-fou railway at Sseutchoan and their relations with geology. From the geological point of view it is shown that the construction of the proposed line would offer great difficulties, and the upkeep would be onerous and costly. From an economic point of view the line would probably prove unprofitable.—V. **Vermorel** and E. **Dantony**: The chemical composition of alkaline spraying mixtures and the soluble copper which they contain. Alkaline Bordeaux mixtures, contrary to the view currently held, contain copper in the dissolved state.—F. **Jadin** and A. **Astruc**: Arsenic and manganese in some plant products used for animal food. Arsenic and manganese are shown to be present in fifteen plant products, and are probably normal constituents of the plant cell.—P. **Mazé**: The mechanism of the exchanges between the plant and the external medium.—J. **Giaja**: Study of reactions of two ferments working together. The hydrolysis of amygdalin by emulsin, or by the digestive fluid of *Helix pomatia*, is shown to be the result of two connected fermentative actions, involving the production of reducing sugar and hydrocyanic acid respectively.—Mme. Marie **Phisalix**: The action of the virus of hydrophobia on Batrachians and snakes.—Pierre **Delbet** and Armand **Beauvy**: Comparative study of the action of ultra-violet light on the hæmolytic power and the colloidal state of blood serum.—Henri **Piéron**: The influence of the state of adaptation of the eye on the laws of decrease of the time of latency for various light radiations.—C. **Levaditi**: Hydrophobia virus and cells cultivated *in vitro*.—G. **Marinesco** and J. **Minea**: The infective power of the cephalo-rachidian fluid in juvenile general paralysis. This fluid has been shown to contain living spirillæ.

BOOKS RECEIVED.

The Commonwealth of Australia. Federal Handbook, Prepared in Connection with the Eighty-fourth Meeting of the British Association for the Advancement of Science, held in Australia, August, 1914. Edited by G. H. Knibbs. Pp. xvi+598. (Melbourne: A. J. Mullet.)

Geologischer Führer durch die Lausitz. By P. J. Beger. Pp. xii+319. (Berlin: Gebrüder Borntraeger.) 6 marks.

Astronomy. By C. Flammarion. Pp. xi+191. (London: Constable and Co., Ltd.) 2*s*. net.

The English Year. Summer. By W. B. Thomas and A. K. Collett. Pp. viii+341+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s*. 6*d*. net.

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1913–14. Vol. lviii., part ii. (Manchester.) 7*s*.

Dante and the Early Astronomers. By M. A. Orr. Pp. xvi+507. (London and Edinburgh: Gall and Inglis.) 15*s*. net.

Proceedings of the Royal Irish Academy. Vol. xxxi. Clare Island Survey. Part 7, Geology. By T. Hallissy. Pp. 22+vi plates+1 map. 1*s*. 6*d*. Part 9, Tree Growth. By A. O. Forbes. Pp. 32+ii plates. 1*s*. Part 47, Archiannelida and Polychæta. By R. Southern. Pp. 160+xv plates. 5*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate.)

The Khasis. By Lt.-Col. P. R. T. Gurdon. Second edition. Pp. xxiv+232. (London: Macmillan and Co., Ltd.) 10*s*. net.

Enquêttes et Documents relatifs à l'Enseignement Supérieur. cix. Année 1913. Pp. 108. (Paris.)

Ergebnisse der Zweiten Deutschen Zentral-Afrika-Expedition, 1910–11. Under the Direction of Adolf Friedrichs, Herzogs zu Mecklenberg. Band. i., Zoologie. Lief. 4. Pp. 89–108. 90 pfennigs. Lief. 5. Pp. 109–134. 1.20 marks. (Leipzig: Klinkhardt and Biermann.)

Elementary Household Chemistry. By Prof. J. F. Snell. Pp. ix+307. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Glamorganshire. By J. H. Wade. Pp. xi+196. (Cambridge University Press.) 1*s*. 6*d*.

Durham. By W. J. Weston. Pp. viii+184. (Cambridge University Press.) 1*s*. 6*d*.

Flies in Relation to Disease. Non-Bloodsucking Flies. By Dr. G. S. Graham-Smith. Second edition. Pp. xvi+389. (Cambridge University Press.) 12*s*. 6*d*. net.

The Family Chain. Marriage and Relationships of Native Australian Tribes. By J. Hopkins. Pp. 31. (London: Watts and Co.) 1*s*.

Die geologischen Naturdenkmäler des Riesengebirges. By Prof. Dr. Gürich. Pp. 141–324. (Berlin: Gebrüder Borntraeger.) 5.50 marks.

Kräfte und Spannungen das Gravitations- und Strahlenfeld. By Prof. Dr. Max B. Weinstein. Pp. vi+64. (Braunschweig: F. Vieweg und Sohn.) 2 marks.

Verflüssigung der Kohle und Herstellung der Sonnentemperatur. By Prof. Dr. O. Lummer. Pp. xiii+140. (Braunschweig: F. Vieweg und Sohn.) 5 marks.

Malaio-Polynesische Wanderungen. By Dr. G. Friederici. Pp. 37. (Leipzig: Simmel and Co.)

Willkommen in Cambridge. Schlichte Antworten auf kluge Fragen. By Karl Breul. Dritte Auflage. Pp. 40. (Cambridge University Press.) 1*s*. 6*d*. net.

Mellon Institute of Industrial Research and School of Specific Industries. Smoke Investigation. Bulletin No. 8. Some Engineering Phases of Pittsburgh's Smoke Problem. Pp. 193+plates. (Pittsburgh, Pa.: University of Pittsburgh.)

Experimentelle Untersuchungen über die innere Sekretion der Keimdrüsen und deren Beziehung zum Gesamtorganismus. By Dr. W. Harms. Pp. iv+368. (Jena: G. Fischer.) 12 marks.

Deutsches Meteorologisches Jahrbuch für 1913. Freie Hansestadt Bremen. Jahrgang xxiv. Edited by Prof. Grosse. Pp. iv+88. (Bremen: Jilling and Lüken.)

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Editorial and Publishing Offices:

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THURSDAY, AUGUST 13, 1914.

AGRICULTURAL BACTERIOLOGY.

Vorlesungen über landwirtschaftliche Bakteriologie. By Dr. F. Löhnis. Pp. viii + 398 + x plates. (Berlin: Gebrüder Borntraeger, 1913.) Price 16 marks.

MODERN research has established the manifold activities exerted by micro-organisms in almost every department of agriculture and the attention of micro-biologists has naturally been directed to a study of the micro-organisms present in soil which influence its fertility, and of those met with in fodder and manure and in agricultural products such as milk, butter, and cheese. The result has been that many books dealing with these subjects have appeared during the last few years, but we doubt if any single volume has been issued which will compare with that under review in the completeness with which agricultural bacteriology is treated in a comparatively short space of five and twenty lectures. Prof. Löhnis has managed to convey an admirable summary of the whole subject.

The volume commences with an excellent historical introduction in which the author directs attention to papers by E. King, published in 1693, in the Philosophical Transactions of the Royal Society, London (vol. xvii), which seem to have been overlooked and which confirm and extend the observations of Leeuwenhoek on the presence of micro-organisms in various organic fluids. The second and third lectures deal with the general morphology, classification, and nomenclature of the bacteria. The author adopts practically the old Zopf classification, remarking that no better one has yet been formulated; with this we cordially agree. Succeeding lectures deal with the biology, cultivation, and investigation of micro-organisms, the circulation in nature of nitrogen, carbon, hydrogen, and oxygen, exchange and decomposition of mineral salts, and the pathogenic functions of micro-organisms, and this completes the first part of the volume. The second part deals with micro-organisms present in fodder, milk and milk products, manure and soil, and the changes which they produce. In this we find accounts of the cellular elements in milk, the heating of manure and hay, nitrification, the possible influence of protozoa and of "toxins" in the soil on fertility, and the use of artificial bacterial fertilisers. In the last connection we miss any reference to Prof. Bottomley's investigations.

The volume is excellently printed and produced, and the illustrations form a striking feature. There are ten plates, of which eight are coloured and admirably depict the objects represented, one of the most successful perhaps being that of a sole glowing with phosphorescent bacteria, a most difficult subject to reproduce. There are sixty figures in the text, some of which are novel. By depicting a rectangular jar of given size with a small black square in it drawn to scale an idea is given of the volume occupied by a certain number of bacteria compared with the volume of the material in which they occur, such, for example, as milk.

R. T. H.

THE CONSTITUTION OF ALLOYS.

Metallographie. By Dr. W. Guertler. Erster Band: *Die Konstitution.* Erster Teil. Heft i.–xii. Pp. 1177. (1909–1912. Zweiter Teil.) Heft. i., *Die Konstitution des Systemes Eisen-Kohlenstoff sowie der sonstigen binären Kohlenstofflegierungen.* Pp. xl + 648 + plates. (Berlin: Gebrüder Borntraeger, 1913.) Price 32 marks.

THE scientific study of alloys has attracted a whole host of investigators during the last twelve years, and the mass of experimental material has increased with great rapidity. Metallography has become a distinct branch of applied physical chemistry, having numerous contacts with mineralogy and with engineering science. There are many text-books dealing with the principles of metallography or with its applications, but the work now in course of publication by Dr. Guertler has a much wider scope. It aims at being a complete treatise on the subject, reviewing critically both methods and results, and also serving as a work of reference. The practical methods of thermal analysis, micrographic examination, etc., and the physical properties of alloys, are left for discussion in later volumes, and the volumes now published deal only with the equilibrium of phases in alloys. The general explanation of the meaning of the equilibrium diagram has been written with the object of making such diagrams intelligible and useful to the technical metallurgist, who may not be acquainted with the principles of physical chemistry. This general account is very clearly written, but the number of new terms introduced, and the rather complicated illustrations of possible forms of equilibrium, may repel some such readers. The discussions of such subjects as diffusion and incomplete equilibrium are excellent.

Just one-half of the first of the present volumes is occupied by a detailed account of binary alloys, classified according to a modified periodic system. Even then, the alloys of the calcium and aluminium groups are postponed to a later section, together with all the ternary alloys and systems of a higher order. The second volume now under notice deals almost exclusively with the iron-carbon system.

Dr. Guertler has thus undertaken an immense task, and has shown marvellous industry in the sifting and presentation of so large a mass of material. The published data referring to each system have been critically reviewed, temperatures have been reduced as far as possible to a uniform scale, and the equilibrium diagrams in which the author embodies his conclusions represent a large amount of patient labour and acute criticism. It is impossible, however, to escape a doubt whether so great an undertaking is justified in the present state of the science. It is well known that very many of the published investigations on this subject have been carried out with rough experimental methods and impure materials, and can only be regarded at best as preliminary surveys. Even the author's critical examination of the data cannot bring conclusive results out of such material. At the present time many of the binary systems are undergoing re-examination by competent investigators, often with surprising results, and for some years to come any systematic account of metallic alloys must be regarded as merely provisional. Such a work as the present is inevitably out of date before its publication is complete. This being admitted, however, all metallographers must be deeply grateful to Dr. Guertler, who has provided them, in a compact form, with a carefully sifted collection of experimental data, otherwise difficult of access, enriched with comments of a thoroughly sound and practical character.

It is an astonishing fact that six hundred pages are required to give an account of the equilibria in a single binary system, that of iron and carbon. The volume devoted to these alloys leaves out of consideration the whole field of the technical treatment of iron and steel, of their physical and mechanical properties, and of the influence of other elements on the system. Probably no better guide than the author could be found through the controversial mazes of this part of the subject, and his conclusions are to be received with all respect. The recent revolutionary proposals of Wittorf and others are subjected to a searching analysis, leading to the conclusion that cementite, Fe_3C, has a range of stability above 1700°, graphite being the stable solid phase between 1700° and 1360°, whilst the existence of a further carbide, Fe_4C, with a small range of stability, is regarded as probable. The thorny subject of the nature of martensite and troostite receives very full treatment, but on this point it would be difficult to find two metallographers who are in complete agreement, and the author's views are not likely to escape criticism. Ingenious diagrams, sometimes having the curves corresponding with metastable equilibria printed in colours, are used in this volume, which is indispensable to all who are seriously interested in the constitution of cast-iron and steel.

The book is admirably printed. In the course of constant use few misprints have been detected, with the exception of proper names, which are rather frequently mis-spelled. References are only given by author's name and year of publication, the details having to be sought in a bibliography, which is to appear on the completion of the work. In the first volume it would have been of advantage to provide a larger number of photo-micrographs in some sections, but those which are included, most of which are fairly familiar, are well reproduced. The second volume is profusely illustrated.

C. H. Desch.

ZOOLOGY, EMBRYOLOGY, AND HEREDITY.

(1) *Handbuch für Biologische Uebungen.* By Prof. P. Röseler and H. Lamprecht. Zoologischer Teil. Pp. xii + 574. (Berlin: Julius Springer, 1914.) Price 27 marks.

(2) *Konstitution und Vererbung in ihren Beziehungen zur Pathologie.* By Prof. F. Martius. Pp. viii + 258. (Berlin: Julius Springer, 1914.) Price 12 marks.

(3) *Leitfaden für das Embryologische Praktikum, und Grundriss der Entwicklungslehre des Menschen und der Wirbeltiere.* By Prof. A. Oppel. Pp. vii + 313. (Jena: Gustav Fischer, 1914.) Price 10 marks.

(4) *Studies in Cancer and Allied Subjects.* Vol. iv., Contributions to the Anatomy and Development of the Salivary Glands in the Mammalia. (Conducted under the George Crocker Special Research Fund at Columbia University.) Pp. v + 364 + plates. (New York: Columbia University Press, 1913.) Price 5 dollars net.

(1) THIS handbook appears to be meant specially as a guide to teachers who have to conduct courses of practical instruction in zoology in higher schools and colleges, but whoever works conscientiously through it, whether a prospective school teacher or not, will have gone through an excellent course in practical zoology on the "type" system. He will have given himself a practical training of a much sounder and more extensive kind than is, we fear, commonly attempted by those who have to conduct such courses in the schools of this country. We fancy that if our science masters had to work through

a course such as is given in the book now under notice we should find them teaching in their turn something rather different from what so frequently, with us, masquerades under the name "nature study."

The opening chapters of the book are of a general nature. A useful inventory of laboratory requirements is followed by practical directions regarding the use of the microscope. Methods of observation of the living animal are described, and thereafter the technique of fixing, staining, section-cutting, and so on. A chapter on general histology gives good practical directions for obtaining the various types of tissue, and that is followed by a chapter on physiology, with good practical exercises dealing with digestion, respiration, milk, blood, and urine.

About four-fifths of the book are taken up by special exercises upon representatives of the various main groups of the animal kingdom. In the chapter on protozoa the sporozoa as exemplified by Gregarina and Monocystis are taken first, then flagellates and ciliates, while our old friend Amœba comes last. This is a reversal of the usual order, and its advantage seems to us very questionable, for, whatever unexpected complexities may turn up in the life-history of *Amoeba proteus*, the fact remains that the ordinary phase in the life-history, which alone is studied in practical classes in zoology, represents an extraordinarily simple and unspecialised type of animal—quite without a rival as a subject of study for the beginner in zoological science.

The chapter on Cœlenterata deals with a couple of sponges, Leucandra and Spongilla (why not a simple Ascon?), Hydra (we notice its cœlenteron is miscalled cœlom!), *Obelia geniculata* (the figure of the hydroid phase appears to represent another species), Aurelia, Nausithoe, Actinia, Alcyonium, and Corallium. Chapters on worms, arthropods, molluscs, echinoderms, tunicates—each deal with various representative members of the group; while vertebrates are illustrated by Amphioxus, Petromyzon, Scyllium, Leuciscus, Rana, Lacerta, Columba, Lepus.

It will be seen that the book covers a very wide area and on the whole it does it well, although necessarily some of the descriptions are very short. Both in the introductory chapters and scattered throughout the book are to be found hints on technique valuable even to those who have considerable experience. The book is amply illustrated, though the illustrations vary much in quality. Some are excellent, for example, those of Astacus and Hirudo (the latter after Hatschek and Cori's beautiful figures); while others, such as that of the transverse section through the earthworm, are very rough. The figures of Ascaris eggs should also be revised for a future edition. On the whole we find the book wonderfully free from gross errors, and we think it will be very useful to students.

(2) This book, with its quaint expressive literary style, and its occasional flashes of humour, forms a very readable section of the Enzyklopädie der klinischen Medizin. The first half of the book is devoted to emphasising the importance of the individual constitution as a factor in disease. The two extreme schools of thought on this subject are referred to: on one hand, the extreme bacteriologists to whom the body is little more than a test-tube containing nutritive medium in which the inoculated microbe can grow and multiply, and to whom the mere mention of the word constitution is looked upon as an attack upon their science; and on the other, the extreme constitutionalists, some of whom have gone the length of looking upon germs as the mere harmless accompaniments of illness.

The second half of the book is devoted to heredity in relation to pathology. Chapter iii. gives a crisply written and, on the whole, fair-minded summary of the theory of heredity and of the main facts of cytology related to it. The author's attitude is eminently common-sensible, and shows a width of view difficult of attainment by the specialist in the study of heredity. He gives full credit of the enunciation of the main idea of the continuity of the germ plasm to Galton in 1875, *i.e.* before both Jäger and Weismann. Due space is given to Mendelism. We notice the verb "mendeln," and the substantive "Nichtsalsmendelianer," though we miss the suggestion of still further developments of the vocabulary on the lines of mendelacious, mendelacity, mendelinquency, mendelette, and so on. The final chapter, which might with advantage have been longer, gives a summary of some of the more important facts of observation in pathology and teratology in relation to heredity.

(3) The author of that admirable encyclopædia entitled the "Lehrbuch der mikroskopischen Anatomie," has in the work now under review succeeded in writing an uncommonly dull book upon an uncommonly fascinating subject. The way in which the book opens—with the sentence "Das volkommenste Forschungs- und Unterrichtsmittel, über welches die beschreibende Embryologie heute verfügt, besteht darin, dass ein Embryo in eine Reihe von dünnen Schnitten zerlegt wird, welche mikroskopisch untersucht werden können"—illustrates admirably the character of the whole work, which is typically

German in its combination of trustworthiness in regard to detail, with almost complete absence of that wide "grip" which makes a work, or a worker, a living force in the development of the science.

Chapter i. sketches the objects and general method of a course in practical embryology; chapter ii., consisting of less than a page, is entitled "Embryology and 'Entwicklungsmechanik'"; chapter iii., about half a page in length, has the somewhat ambitious title, "Evolution, Epigenesis, Neo-evolution, Neo-epigenesis." After this it is somewhat startling to find that chapter v., "On some of the causal factors of development," which teaches the student various excellent Rouxian expressions in which his—and his teacher's—ignorance may be safely wrapped up, extends over some eight pages. Many long and Greek-looking words occur in this chapter, and we confess to being not altogether convinced that they serve a useful purpose. We do not quite see of what special advantage it is to a German student—apart from some slight economy in time or ink—to refer to the wandering apart of cells which had come together as "Cytochorismus," instead of using the expressive vernacular "Wiedervoneinanderlösung." Technical terms are, of course, very necessary things, but there is often a danger—and it is one from which biological science is suffering greatly at the present time—that the affixing of a new technical name may be counted as *explaining* a natural phenomenon, or as making at least a definite step towards explanation.

The first section of the book is completed by a short but good account of simple embryological technique suitable for elementary students, followed by a short sketch of developmental mechanics and a syllabus of work for a course in practical embryology.

The second section of the book gives a good, though rather too short, general account of germ cells, early stages in development, and fœtal membranes. The third section gives directions, illustrated by outline drawings, for working through series of sections of various vertebrate embryos, while the concluding section of the book gives a short but good sketch of vertebrate organogeny.

The book is excellently illustrated. It is too short, and it has, as we have indicated, other faults, but it is, on the whole, trustworthy, and will, we doubt not, serve its purpose to the student who hustles through a course in vertebrate embryology with the idea of picking up some knowledge of its methods rather than of becoming acquainted with its general principles as a branch of evolutionary science.

(4) Vol. iv. of the "George Crocker Studies in Cancer and Allied Subjects" consists of a series of eight valuable memoirs upon the anatomy and development of the salivary glands of the mammalia. Adult anatomy is dealt with by Carmalt (man, carnivora, ungulata, rodentia, insectivora, marsupialia) and Huntingdon (lower primates); embryonic development by Schulte (man, cat, pig); while the evolution of the primate salivary glands out of the presumably ancestral condition of a diffuse gland-field is discussed by Huntingdon. Taken altogether the volume forms a valuable addition to our knowledge of the morphology of the salivary glands of the mammalia, and incidentally it affords a striking tribute to the wise and broad-minded administration of the George Crocker Research Fund of Columbia University.

TROPICAL PRODUCTS.

(1) *The Cultivation of the Oil Palm. Some Essential Notes.* By F. M. Milligan. Pp. xiv+100. (London: Crosby Lockwood and Son, 1914.) Price 2*s.* 6*d.* net.

(2) *Rubber: Its Sources, Cultivation, and Preparation.* By Harold Brown. With a Preface by Dr. W. R. Dunstan. Pp. xiii+245+xii plates. (London: John Murray, 1914.) Price 6*s.* net.

(3) *The Banana: Its Cultivation, Distribution, and Commercial Uses.* By W. Fawcett. With an Introduction by Sir Daniel Morris. Pp. xi+287+plates. (London: Duckworth and Co., 1913.) Price 7*s.* 6*d.* net.

THE trio of books under notice deal with three important tropical products, the first being chiefly associated with European colonies in western equatorial Africa, the other two being widely exploited.

(1) The luxuriance and abundance of the oil-palms in the coastal lands from Sierra Leone to the Cameroons furnish good evidence that the climate is particularly suitable and that the tree is well able to hold its own against plant and insect pests. The supply of fruit and nuts was originally obtained from wild plants, but plantations have been formed by natives and are being extended. Undoubtedly there is scope both for extended planting and for more careful cultivation. It is with the object of offering advice in these matters that Mr. Milligan has written his book. Unfortunately, although there are many allusions to his experience, the information given is exceedingly meagre; on the subjects of seed-germination, planting, and manuring, the advice is sound, but in other respects, notably as regards botanical details, the information is not only insufficient, but incorrect. The subject of oil-production is not included.

(2) The present time is very opportune for a review of the plants and methods connected with rubber production. During the last few years a number of outstanding problems have been critically determined or investigated, primarily by planters and agricultural officials in the producing countries, and, to a less degree, by workers in museums and laboratories. Thus there is a fairly general agreement with respect to the limitations of climate required by the Para rubber tree, *Hevea brasiliensis* and the Ceara rubber tree, *Manihot glaziorii,* and the sources of the various native-prepared rubbers; also opinions have gradually crystallised with regard to the best methods of tapping Hevea, the different requirements for Manihot, the African rubber tree, *Funtumia elastica,* and other trees, and the various methods of producing coagulation of latex. On all these matters Mr. Brown provides a valuable mass of recorded observations and sifted conclusions, together with summaries of quantities of latex obtainable and analyses. Two chapters are devoted to the rubber industry in British Africa and the principal rubber-yielding plants. The chapters on latex, tapping, preparation, and chemistry of rubber are particularly interesting because the author is specially qualified to write on these subjects. With reference to the botanical determinations of the various species of Landolphia, Manihot, and Ficus, reference is made to the sources from which the data are collated. The book is certainly one of the most useful contributions to the subject of rubber production; not the least interesting paragraph is that in which an opinion is given as to the competition with synthetic rubber.

(3) The greater part of Mr. Fawcett's book on bananas is occupied with an account of the cultivation of the banana in Jamaica, its dietetic value and by-products and the development of the banana trade. The chief points treated in connection with cultivation are details of the plant, flowers and fruit with illustrations, the pruning and treatment of suckers—a very complex and important matter—mulching, fertilisers, diseases, and pests. The later chapters are devoted to a comprehensive review of the cultivation of different species and varieties of bananas and plantains throughout tropical countries, including India, Queensland, Egypt, Natal, various African colonies, and States in Central and South America. Into many of these the Jamaican and Canary banana plants have been introduced for cultivation; the former is a variety of *Musa sapientum,* known as Gros Michel, that originated as a sport in Martinique; the latter is *Musa cavendishii.* The Jamaican banana is better fitted for transport, but the plant is liable to be wrecked by strong winds. Attention is directed to the by-products, dried bananas, known as "banana figs" and banana flour, also to the cooking recipes. The book is recommended as a comprehensive and authoritative compilation, characterised by clearness and accuracy. An item of special botanical interest is the list with chief characters of sixty-six species of Musa.

ENGINEERING MANUALS AND TEXT-BOOKS.

(1) *Suspension Bridges, Arch Ribs, and Cantilevers.* By Prof. W. H. Burr. Pp. xi+417. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 19*s.* net.

(2) *Technical Mechanics, Statics, and Dynamics.* By Prof. E. R. Maurer. Pp. vii+356. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 10*s.* 6*d.* net.

(3) *Mechanical Refrigeration.* By Prof. H. J. Macintire. Pp. ix+346. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 17*s.* net.

(4) *The Human Factor in Works Management.* By J. Hartness. Pp. ix+159. (New York: McGraw-Hill Book Co.; London: The Hill Publishing Co., 1912.) Price 6*s.* 3*d.* net.

(5) *Elasticità e resistenza dei corpi pietrosi Mattoni, Pietre, Malte e Calcestruzzi, Murature.* By Ing. Alfredo Montel. Pp. vi+180. (Torino: S. Lattes and Co., 1914.) Price 5 lire.

PROF. BURR is so well known as a writer on bridges that another work from his pen will be welcomed by engineers, particularly as he deals with the problems connected with large suspension bridges, about which he is particularly qualified to speak as a consulting engineer. The problem of the stiffened suspension bridge in general is dealt with in an exhaustive manner, preceded by a treatment of the perfectly flexible cable or frame loaded vertically. A useful table is given for the lengths of cables assuming a parabolic form, an assumption which is generally made by engineers in designing, for the loading is so nearly uniform per unit of length of span that the catenary is almost the same as the parabola. This leads to an interesting deduction as to the approximate greatest length of span for different ratios of central deflection of cable to span. Thus, taking 60,000 lb. per sq. in. as the working stress for steel wire and the above ratio 10, we find that a span of 13,740 ft. is possible. The friction in the joints of a link cable is shown, and the stresses due to friction in the pins of eye bars become larger than is generally supposed, and the resulting bending moments are by no means negligible. The theory of the straight stiffening-truss based upon the elastic deformation of the structure assumes that there is no sensible variation from the parabolic form of cable or frame. The thermal stresses in stiffened suspension bridges are discussed. This work should find a ready acceptance among engineers and students alike.

(2) It is not surprising that this work has reached a third edition in ten years for it possesses distinct merit and originality. Unlike the usual text-book on mechanics which is compiled by rigid adherence to academic method, it has a treatment all its own, and one that will commend itself alike to teachers and students who have left the abstract for the concrete problems met with in practical application. The author asserts that it is neither theoretical mechanics on one hand, nor applied on the other, since it does not include strength of materials, and the reader will not go far before discerning a judicious blend between the two extremes. The thirteen chapters comprise statics, friction, centre of gravity, rectilinear and curvilinear motion, translation and rotation, and work, energy, and power. The illustrations are clear and essentially represent objects familiar to the engineer.

(3) A short introductory chapter to this volume is devoted to the usual thermodynamic relations for air and other vapours, after which the various types of refrigerating machines and their construction are described. This is followed by the theory of refrigeration and the choice and properties of refrigerating mediums. We then find a chapter on testing refrigerating machines, followed by a discussion on insulation; and finally, the various commercial applications are dealt with. The discussion on refrigerants has been brought up to date by including the work of Mollier and others. The descriptions of refrigerating plant and methods are very complete.

(4) A perusal of this work will leave the reader in doubt as to the object of the writer, and yet he will conclude that it is an interesting and pleasantly written essay upon the motives and habits of the workman in the pursuit of his work. As human nature is the same the world over, it will doubtless be found to meet the characteristics of the English as well as the American workman, and perhaps to suggest to the employer some of the causes which have operated to give a nation a certain place in the industrial world. To American managers who have given the problems of works management a position among the sciences it would make a direct appeal, and though most men of experience would find their views in general accord with those of the author, it is pleasant to find them confirmed by one who has evidently a clear and shrewd apprehension of the actuating forces that underlie all human endeavour. We would however be inclined to say *ça va sans dire* to much that the author has written. For instance, few will find fault with the statement that inertia is not confined to an inanimate mass and that it has to be overcome in a progressive business. Notwithstanding the somewhat trite remarks that we find throughout the work, there is a distinct charm about the manner of presentation, and as the author confesses to a feeling of incompleteness in the treatment, we must take what he has given us with this reservation and accept his contribution to a very large subject capable of indefinite variation.

(5) This work on the strength and physical properties of bricks, stone, mortar, cement, and masonry is a compilation of results of experiments with a discussion of the theory of elasticity as applied to such materials. The first chapter deals with the elastic properties in reference to Hooke's law and Poisson's ratio for the materials, and in the second the behaviour of materials under compression is dealt with, which is followed by a chapter on the flexure of beams. The ordinary tensile tests on various kinds of cement are described and the results tabulated. The strength of bricks based upon various experiments made by different men is, in view of the variable character of the material, of special interest, also the crushing strength of building stones of different kinds is given. The chapter on the crushing strength of brick piers is of special value as so little has been done in this direction, chiefly owing to the inherent difficulties of testing and rendering the results comparative. The effect of the quality of the bricks and mortar and the workmanship is discussed, the results obtained by Popplewell, Howard, and others being cited. The thickness of the joints, leading dimensions, and other possible variations in the test piers make it impossible to lay down any absolute laws as the result of the tests. The work ought to be of use to engineers as a guide to what has been done in a very large subject.

OUR BOOKSHELF.

Minerals and the Microscope: an Introduction to the Study of Petrology. By H. G. Smith. Pp. xi + 116 + xii plates. (London: Thomas Murby and Co., n.d.) Price 3*s.* 6*d.* net.

THE author of this convenient and systematic little treatise is Demonstrator of geology in the Imperial College of Science, London, where he has gained experience through the introduction of large classes to the use of the microscope in petrology. The style is clear, and sufficient optical theory is introduced to add interest to determinative methods. The philosophic processes by which minerals are determined, affording as they do an insight into crystalline structure, are of far more value in class-work than actual specific identifications. The beautiful series of photographs of minerals as they appear in thin rock-slices is a very welcome feature, and gives special distinction to the book.

As an "introduction to petrology" the microscopic method often fails; this is seen, for instance, where the author (p. 103) regrets the difficulty of distinguishing the triclinic felspars present in a granite. Surely, in a coarse-grained rock, a fragment broken from the mineral will supply material for other than optical tests. We do not know, again, how "microscopic investigation should always enable the student to make the distinction" (p. 112) between foliation and bedding, seeing that the two so frequently coincide in schists. But Mr. Smith has given us the handiest and best illustrated introduction that we possess to an important aspect of rock-minerals, and has even included a coloured plate of Newton's scale. If the student remembers that every rock-section has its parent rock, he may well place himself at an early stage of his work under the guidance of these lucid pages. G. A. J. C.

Researches into Induced Cell-reproduction in Amoebae. By J. W. Cropper and A. H. Drew. Pp. 112 + plates. (The John Howard McFadden Researches, Vol. IV.) (London: John Murray, 1914.) Price 5*s.* net.

THE investigations described in this volume were undertaken with the view of supporting the theory of H. C. Ross, that cell-reproduction is brought about by certain chemical agents termed "auxetics," and that their effect is increased by the addition of other substances known as "kinetics." The authors claim to have confirmed this theory, and to have shown that the mode of action of these substances is probably through the medium of enzymes. The presence of these agents in the environment is stated to produce variations in the morphology of the organism. Methods of cultivation of amœbæ and their examination by the "jelly method," are described. The encystment of an amœba is stated to be due to the action of certain deleterious bacterial products, and it is claimed that the subsequent excystation is caused by other products which act on the cyst-wall from without, and are of the nature of ferments. A detailed account is given of the preparation of cultures of the amœba with pure strains of different bacteria. The amœba used in these researches was a species found by the authors living in a solution of sodium chloride (1 per cent.) and sodium citrate (3 per cent.) in the laboratory, and named by them *Amoeba ostrea*. A parasitic micrococcus, which was very deadly to the amœba, was also isolated and investigated.

Song and Wings: a Posy of Bird Poems for Young and Old. By Isa J. Postgate. With a Preface by the Rev. Canon H. D. Rawnsley. Pp. xi + 50. (London: Alexander Moring, Ltd., 1914.) Price 2*s.* 6*d.* net.

MISS POSTGATE'S pretty verse will serve a very useful purpose if, by arousing an interest in birds and bird-life, it assists in the arrest of the extermination of beautifully plumaged birds for the gratification of the desire for barbaric adornment fostered by modern fashion.

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.]*

Asymmetric Images with X-Radiation.

CONFIRMING our letter of July 16 on asymmetric haloes, we have found that the bands can be produced on one, *two adjacent*, three, or all sides of a square (lead), and when an obstacle is placed at or over one side the corresponding band only vanishes. These effects are independent of the incidence of the radiation. With V-shaped aperture, the apex resting on the plate, the bands on one side are sharply defined, and twice bent; on the other there are several, and they are diffuse and fainter.

The double bend is due to the fact that within a short range two edges contribute as in light.

With strips (steel), say, 4 cm. width, the white bands *cross* at various angles depending on the slope to the plate, but are afterwards dispersed at short distances from the edges they approach.

The diametric asymmetry excludes polarisation, and since it increases directly with the distance from the axis through the "optimum" (*i.e.* 15° from the direction at which light would be reflected) the rays must have some determination from the plane of the anti-kathode. In other words, they must be "polarised" in planes at successive angles to the direction of propagation. The continuance of the bands within the shadow beyond the range of light diffraction and their varying asymmetry show that X-radiation is something more than light of very short wave-length, or otherwise light itself must possess unequal polarity in its structure.

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Unit of Acceleration.

IT is a little surprising to find in Dr. Shaw's paper (December 16, 1913), ". . . He (Mr. Whipple) points out that we have no special name for the unit of acceleration." In NATURE of June 25, 1914, Mr. Whipple proposed the name "leo." So long ago as 1909 Wiechert used the term "gal" in the report for the Göttingen earthquake station for that unit, being the first syllable of Galileo, whence Mr. Whipple derives his "leo." Others, as well as myself, have used "gal," or rather "milligal," in analyses of earthquakes. A milligal is approximately a millionth of *g*. Dyne is the unit of force, gal the unit of acceleration.

OTTO KLOTZ.

Dominion Observatory, Ottawa, July 18.

THE NESTING HABITS OF ADÉLIE PENGUINS (PYGOSCELIS ADELIÆ).

WHEN they arrive at the southern rookeries in the early spring, the penguins appear to be quite unattached, and pairing takes place during the ensuing week or two. As they spend the winter on the floating pack ice, far out to the northward, they have a journey of some hundreds of miles to get to their rookeries, and are therefore much fatigued on arrival. Consequently, many are seen to spend their first day or so in resting, either on the sea ice, or on the solid ground on which the rookery is formed.

The hens betake themselves either to old nests, or else scrape little scoops in the ground, which they previously thaw by squatting on it for a short time. They sit in these scoops, and wait until mates come to them. Were they not very jealous of one another, the cocks might easily get mated and start domestic life without any trouble. Unfortunately, however, the jealousy which characterises the animal kingdom in general when engaged in matrimony, is ingrained in the character of the Adélie cock in its most violent form, so that bands of these little warriors are to be seen all over the rookery, watching each other's every movement, and hindering one another in their quest for wives. As soon as one of their number approaches a hen, one or more of his companions sails in at him, and a desperate battle takes place, each bird raining in blows with his powerful "flippers," and fighting with the most indomitable bravery. As a rule, after some preliminary squabbling, two of the band are seen to settle down to a serious encounter (Fig. 1), in which each uses his weight, leaning his breast against his opponent, so that as one begins to outlast the other the weaker bird gets rushed out of the crowd, and the fight ends on some open patch of snow, when the victor has his enemy down, and hammers him until he cannot rise or beats a retreat.

FIG. 1.—Two of the band in serious encounter.

After this the conqueror returns to the hen, and as likely as not fights another of the band. Thus hours may be spent over the winning of a single hen. At length there seems to be an agreement that one of the knights has established his right to the lady. As a rule, it is the strongest and cleverest fighter of the group; but, curiously, this is not always so, as sometimes the bird who has undoubtedly proved himself the victor suddenly walks off, and by general consent his vanquished opponent is left in possession of the field.

His troubles are not yet ended, as the hen has yet to make up her mind that she will have him. His first overture very often takes the form of an offering in the shape of a pebble for the nest. This he lays in front of her, and it may suffice; but often it does not, and she responds by pecking him furiously, whilst he hunches himself up, with closed eyes, making not the least resistance nor any attempt to evade the onslaught.

When she desists, he rises and sidles up to her, arching his neck and looking very pretty and graceful in his efforts to ingratiate himself. Then perhaps both have some sort of argument, facing one another, their heads stretched upwards and rocking from side to side as they appear to discuss the matter in raucous tones. Gradually they become calmer, until finally the matter is settled and they have pledged their faith for the rest of the season.

Fig. 2.—An adélie penguin sitting on eggs.

Once made the compact is final, and though, unhappily, death from misadventure breaks up many a home, those that survive remain unswervingly faithful to one another. Overtures are frequently made by unmated cocks to mated hens during the early part of the year, before the eggs have come, but the husband takes good care of his wife, and soon drives off the interloper.

The pair being wedded, the cock fetches stones for the nest, which the hen builds. A week or so elapses and the first egg is laid. In two or three days' time the second appears. Up to this time none of the birds attempt to get food, but when the eggs are both laid one of the pair goes off to the nearest open water, and may remain away a week or ten days, after which it returns and takes its turn on the eggs (Fig. 2), whilst the other goes off for a similar period to catch the little shrimp-like crustacea that abound in the Antarctic seas, and to gambol with groups of neighbours in the water and on the sea ice.

The eggs take about thirty-two days to incubate, and at the end of this time the little plush-coated chicks appear all over the rookery. These grow at a great rate, eating voraciously. Some idea of their rapid growth may be got from the photograph showing a chick twelve days old (Fig. 3).

Now the adult birds are extremely fond of playing games, and spend whole days in playfully skirmishing with one another on the sea-ice near the rookery, and having rides on the ice floes that drift past on the tide. Consequently, the needs of the youngsters becoming greater as they grow bigger, when these are about a fortnight old an ingenious social arrangement is made by the entire rookery, resulting in a great economy of labour. Hitherto, the greatest care has been taken by the parents to prevent the chicks from straying away from the nests, because when they do so they are invariably pounced upon by the skua gulls which are always in attendance to prey upon them, and should the chicks seek the protection of neighbours the latter would only drive them away with savage pecks which might prove mortal to the tender youngsters.

Now, however, by mutual consent all this is changed, and the occupants of large groups of nests (Fig. 4) pool their chicks so as to form *crêches,* sometimes consisting of many dozens of youngsters, which are guarded by a few old birds who take turns to remain on duty whilst the rest are free to go off to get food and to play. The sentry birds take good care of the *crêches* under their charge, and soon drive in any of the chicks that try to get away, so that these learn to keep in a cluster and are safe from the attacks of the skuas.

Fig. 3.—A chick twelve days old.

Surely this is a most wonderful development of social instinct on the part of a colony of birds.

When the chicks have changed their downy coats for a covering of feathers, it is time for both young and old to depart. The sun will soon be gone, the sea be frozen over, and the long Antarctic night begun. So the youngsters make their way to the water's edge, and here they learn to swim and to catch their own food. Some take to the water at once; others are more tardy, and these are encouraged to enter the new element by the old birds, who take pains to show them that they are as safe here as on land. Then in bands of some dozens at a time, the whole rookery takes to the sea and departs for the north, where the floating pack ice of the Antarctic seas affords them a safe home and the proximity of open water from which they must derive their food.

G. MURRAY LEVICK.

FIG. 4.—A group of nests.

RECENT PROGRESS IN AERONAUTICAL SCIENCE.

TWO lectures delivered recently have directed attention to striking progress in the development of aeronautical science. Simultaneously with these lectures, the "Wilbur Wright" lecture by Dr. R. T. Glazebrook, and the "James Forrest" lecture by Mr. F. W. Lanchester, results are published of experiments on an inherently stable aeroplane, the RE 1, constructed at the Royal Aircraft Factory. The two lectures and the flying machine are not wholly unconnected with each other.

Stable aeroplanes have been built before; Lieut. Dunne, Mr. Handley Page, and others, have produced aeroplanes which are inherently stable, and yet the RE 1, from a theoretical point of view, has an importance of a different character from its predecessors. If the older machines be examined they will be found to possess marked peculiarities in their wing construction, and in some cases have been clearly produced as the result of the study of natural wing forms. In all cases, however, the design is primarily based on the requirements for stability, and the strength of construction is a matter for important but secondary consideration.

On the other hand, as was remarked in a recent number of one of the technical flight periodicals, the absence of special stability features in the RE 1 is striking. Superficially, the aeroplane differs little from standard biplanes designed chiefly for strength and efficiency, and the procedure followed in its production was a complete reversal of that leading to the older stable machines. It is shown clearly that neither ease nor strength of construction nor efficiency need be sacrificed in order to obtain a stable aeroplane.

Like many other achievements, the RE 1 is not the sole production of any one person. The credit for some of the earlier links in the chain must go to those early mathematicians—Lagrange, Kelvin, Routh, etc.—who put the theory of the small oscillations about a state of steady motion on to a sound and regular footing. Later, the method has been applied to the particular problem of the aeroplane by Prof. Bryan, whilst, at the same time, Mr. Lanchester, working from first principles, developed the same conditions for the production of longitudinal stability. Both investigations are dependent for numerical data on the results of experimental research on models, and in producing this the aerodynamical laboratories are concerned. In England such data are produced at the National Physical Laboratory, whilst France, Germany, Italy, and Russia have each one or more institutions for the purpose of aeronautical experiment.

Finally, there are the constructors and pilots who apply the results to practice. In the case of the RE 1 the application was made by the Royal Aircraft Factory, the pilot being responsible, not only for the flying of the machine, but also for the adjustments necessary to produce the desired amount of stability.

The mathematical analysis, most clearly expressed in Prof. Bryan's work on "Stability in Aviation," has shown that for all aeroplanes the motion may be considered as dependent on four surfaces. The surfaces need not have any exact material existence in the aeroplane but are equivalent to the sum of the effects of all the separate parts. The position of these surfaces can be described quite shortly; the largest of them carries practically the whole weight of the aeroplane, and in a monoplane is almost identical with the main planes. A second surface roughly parallel to the supporting surface and behind it is used to obtain longitudinal stability, whilst two vertical surfaces, one above and the other behind the main supporting surface, are necessary to produce lateral stability. The equivalent surface above the main planes is usually produced by turning up the wings near the body so as to make a dihedral angle, whilst that behind the main planes is in large part provided by the rudder and fixed tail fin.

Each of these equivalent surfaces is somewhat complex in character, and in particular the rear vertical fin is dependent on whether the propeller is running or stationary. Theoretical considerations indicate that any good flying machine can, however, be made stable by suitable choice of these four equivalent surfaces without affecting appreciably the design of the aeroplane from the point of view of efficiency and strength. Actual flight has shown how in one particular case, at least, it has been done.

The problem of flight, however, is more difficult than that of producing stability, and further analysis brings into prominence the importance of knowing the amount of stability. In the course of the Wilbur Wright memorial lecture, Dr. Glazebrook exhibited diagrams which, amongst other things, showed the amount of the rise and fall of a stable aeroplane in a moderate wind, this rise and fall being necessary for recovery from disturbance. As a deduction from these diagrams it appears that in really rough weather a stable aeroplane might be tossed about to an uncomfortable extent. The analysis which leads to this result also indicates a remedy, and by an extension it is possible to investigate the effect of moving the controls of an aeroplane and so to utilise the result as to produce a mechanical device for reducing the tossing. It is perhaps unwise to attempt to prophesy, but it appears to be probable that the aeroplane of the future will be inherently stable, with a degree of stability now thought undesirable, and that it will be provided with a mechanical device for operating the controls so as to reduce the effect of an external disturbance. Near the ground the pilot will always need to take control, for then the manœuvres may require to be quite different from those natural to the flying machine.

Problems of an urgent but entirely different character are also presenting themselves to the constructor for solution. A suitable engine is still being sought for, whilst the problem of safe alighting is probably the one now presenting the greatest number of difficulties.

TECHNICAL EDUCATION FOR FISHERMEN.

We noticed, a short time ago (May 28, p. 324), the report of the Departmental Committee on Inshore Fisheries, but did not deal fully with the sections relating to education. Some of the recommendations made in the Report are most useful in so far as they direct public attention to the question of the better education of fishermen. We feel, however, that they do not suggest any useful advance upon what is already being done by certain local authorities under the stimulus of the Board of Education; and it is evident that the committee, in their desire to report speedily upon the other more important questions referred to them, did not fully acquaint themselves with the real conditions at the fishing ports so far as the instruction of fishermen is concerned.

Two distinct questions are involved: (1) that of the better education of the deep-sea men, and (2) that of the education of the inshore men.

(1) *The Deep-sea Fishermen.*—Until a few years ago it seemed as if the craft of the fisherman were almost the only one for which technical instruction was unnecessary. For centuries the methods of trawling, drifting, and lining have been carried on with essentially no modification. But with the development of the modern deep-sea fishing vessel, and the enormous industrial change which has followed this, there arose the necessity for a real knowledge of working methods of navigation. Even for such vessels working in the shallow seas a sound acquaintance with the rule of the road was necessary; and when steam-trawling became extended to Icelandic waters, the Barentz Sea, and the coast of Morocco, it became evident that there was little in the way of a knowledge of navigation, as it is practised aboard a transatlantic liner, that was not also required by the master of a steam-fishing vessel. Repeated and lamentable losses of life and property, experienced even during the last few months, have driven home this truth in the minds both of owners of fishing vessels and of

Board of Trade officials, so that the standard of proficiency expected from candidates for fishing certificates is now rapidly approximating towards that expected from foreign-going merchant service officers. This is as it should be, and under the stimulus of the increasing stringency of the Board of Trade examinations, and the active oversight of the Board of Education, fishery navigation schools are successfully being worked at Fleetwood and Piel, Grimsby, Hull, and other places. So much for the purely professional training of the fishermen, but with that desire to be "practical" which so appeals to the local administrators of public money, such handicrafts as seamanship, net-making and mending, engineering, knot-making, splicing, and cookery are also taught, with, we fear, indifferent success.

Nowhere in England, except at the Lancashire Sea-Fisheries Committee's Laboratory at Piel, Barrow-in-Furness, has marine biology and oceanography been taught. Usually instruction in those subjects has taken the form of public lectures given at the fishing ports, and no one who has had personal experience of this method of education can claim that it is even moderately successful. Systematised instruction in marine biology, so far as it relates to marine economic animals, was instituted in Lancashire in 1900, and has been continued in a gradually modified form ever since then. Personal laboratory work is done by the men, and the usual methods of instruction by means of lectures and demonstrations are also carried on in a very thoroughly equipped marine biological station. Scholarships are awarded by the county education committee to men who indicate their fitness for the instruction, and each fisherman student spends a fortnight at Piel, working from five and a half to nine hours a day for a fortnight. At the present time the instruction includes marine biology, seamanship, oceanography, and navigation. It is intensive and systematised, and has been successful to an extent indicated by the ease with which the men selected have obtained Board of Trade certificates; by the disappearance of the hostility with which the early attempts at fishery regulation were met; by the applications of scientific principles which have been made by the fishermen themselves in some localities; and by the ready cooperation of the men in the work of fishery investigation—in obtaining statistical data, for example.

Apart from such systematised instruction, deep-sea men can only educate themselves by infrequent, and mostly evening, attendance at the navigation schools, or at occasional fishery lectures. In itself this is an unsatisfactory method of instruction, and one which demands considerable expenditure of money, and of the very limited leisure time enjoyed ashore by these fishermen. But an equally serious difficulty is the defective elementary education of the men. At the present time a boy cannot go to sea in a deep-sea vessel until he is sixteen years of age, or unless he is apprenticed—a system of employment which is disappearing in most ports. He leaves school at fourteen, and the two years' interval is often spent in undesirable forms of shore employment, or in some form of inshore, or shore, fishing; and during this time what little primary education he did acquire mostly lapses. It is in these years, and during the first year or two of life at sea, that the education of fisher lads must be organised. It is not asking too much from the employers, during this period of a fisher-boy's life, that they should be made to send him to school on full or modified pay for, say, two or three months in the year to receive continuous and systematised instruction. It *is* asking too much from the lad, or from his parents, that he should either obtain his education by attending evening school after a long day's work, or by sacrificing a considerable fraction of his earnings. If the technical education of the fishermen is greatly to be improved this sacrifice should be expected from the employers of lads.

(2) *The Inshore Fishermen.*—It will probably be found impossible in actual practice to set up different systems of technical education for lads likely to become inshore or offshore fishermen. To begin with, it is clear that what a boy will become when he attains the age of sixteen depends on "chance," on temperament, or on opportunity. Some knowledge of the conditions on part of our coast convinces us that it is generally the lad who becomes "shiftless," either from temperament or example, or he who is naturally impatient of discipline or routine, or he whose parents desire to make the most of him regardless of his future, that swells the numbers of inshore fishermen, mussellers, cocklers, shrimpers, etc. It is all work that a strong boy, brought up by the seaside, can do almost as well as a man; work at which he can earn much more than he could at a skilled trade or in deep-sea boats—generally where a superior technique is required. A lad of this class who is ambitious and has received a tolerably good primary education will go to sea, not as an inshore fisherman, but either as a deep-sea fisherman, or in the merchant service. So far, then, as a primary education for a seaboard population can be specialised it should become one which includes simple science—marine biology and oceanography—if these matters can be taught at primary schools without prejudice to a plain elementary education without imperfectly taught fads.

The organisation of the continuation education—that which we suggest should be given, not in evening classes, but continuously as a fisher-lad's daily work throughout some part of the year—presents the greatest difficulty. There is no difficulty with respect to what ought to be taught the lad who is going to sea in deep-sea fishing vessels: what he must learn is still the "three R's," and such things as nautical astronomy, trigonometry, marine architecture, and magnetism. But are we really going to help our inshore fishing population by attempting to teach the boys "ropework, sail-mending, signalling, carpentry, and metalwork," "practical courses on marine motors and their installation, net-mending and the preservation and curing of fish," and "business methods" all in continuation evening classes? Surely these are not school subjects, but handicrafts, and surely the attempt to teach them in schools is merely overloading a primary education already burdened by sufficient imperfectly taught "subjects." If these things are to be really useful they must be acquired by a boy in the daily practice of his occupation.

If scientific instruction can be given in addition to the above, so much the better, say the inshore committee. It is proposed that this instruction be given by "occasional lectures." These would explain "the most up-to-date methods as well as the cogency of the case for any newly imposed by-laws." They would "obviate any resentment felt for ordinances" and "convince fishermen of their expediency." Would they? The experience of the Lancashire local committee, which first in England attempted to regulate, by restrictions, a large inshore fishing population was that any attempt to argue for (or explain) by-laws by means of public lecture was fatal at once. But simply to impart, by means of sound laboratory instruction, the main things in the life-histories of marine economic animals—that is, by pure scientific instruction—has gradually effaced the intense hostility to legislative interference which those who began fishery regulation in England experienced. This end has to be attained *indirectly*. It is like the much-discussed question of sex-hygiene instruction. Why not plainly teach human physiology? And must one still apologise in England when he wishes to impart a scientific education?

Certainly methods of preservation, curing, marketing, etc., ought to be described in lectures and informal conferences; certainly methods of fishing in use abroad or in other parts of the country should be demonstrated; certainly the choice and upkeep of motor installations should be the subject of informal meetings and conversations, all these things being described to inshore fishermen by "practical" men or tradespeople. But this is rather organising the industry than educating the fishermen. J. J.

SECULAR CLIMATIC CHANGES IN AMERICA.[1]

NEITHER the meteorologist nor the geologist commonly realises the extent and importance of the changes which have taken place during the "historic period." The latter is apt to close his investigations with the Ice Age; the former too often concerns himself only with the period of instrumental observations. The intervening "post-Glacial" time is the field of relatively few workers, who are rapidly building up the new science of "Palæoclimatology."

Prof. Huntington's elaborate memoir on the "Climatic Factor" should do much to gain recognition for at least the later stages of this period. From the viewpoint of the "pulsation" theory of climates developed during similar investigations in arid Asia, the author studies the climates and their attendant effects during the last thirty-five centuries over an area extending from California to Guatemala. A study of the ruins of arid New Mexico shows that at three distinct periods prior to the coming of the Spaniards the country was able to support a far greater population than can exist at present; this could only have been possible with a heavier rainfall, permitting the cultivation of regions now too dry for agriculture. The strand lines and gypsum dunes of the Otero Soda Lake and the alluvial terraces of the rivers point to the same conclusion (though the theory that even in rivers reaching the sea terraces and deltas are the result of changes of climate rather than of level will come as a shock to most English geologists).

In America there are no continuous historical records from which the ruins can be dated; this deficiency is supplied in an unexpected way by the measurement of the rings of growth of the giant Sequoias of California, some of which are more than three thousand years old. By means of an empirical formula, Prof. Douglass, in a chapter on a method of estimating rainfall by the growth of trees, has been able to reconstruct the rainfall, for the period over which records exist, with an accuracy of 82 per cent. With the very old trees, however, a number of corrections are necessary, which render uncertain the slope of the curve plotted from the measurements, although they do not impair the evidence of short-period fluctuations. The corrected curve shows cycles of 155 years, of 21·0 years, and of 11·4 years, and in addition three long wet periods, from 1000 B.C. to 300 A.D., from 900 to 1100 A.D., and from 1300 to 1400 A.D., which Prof. Huntington considers must correspond to the three native civilisations of New Mexico.

This curve is next compared with the curve previously published in "Palestine and its Transformations," showing the fluctuations of climate in arid Asia. There is a pronounced agreement between the two curves, especially during the period from 300 to 1000 A.D.

The Maya civilisations of Yucatan and Central America are next investigated—though, since these regions largely suffer from an excess of precipitation, they can scarcely be included in "*arid*" America—and the theory is developed that these extinct civilisations fell in dry, cool periods contemporaneous with the moist periods of New Mexico, both changes being the result of a southward movement of the subtropical anticyclone. The coolness stimulated the Mayan races into activity, and the dryness enabled them to master the forest. The dates of the Maya chronology are not yet satisfactorily worked out, but so far as they go they confirm this correlation. An attempt is made to connect the terrestrial changes with changes of the sun's surface, but the results, which are illustrated by curves, do not appear to

[1] "The Climatic Factor as Illustrated in Arid America." By Ellsworth Huntington, with contributions by Charles Schuchert, Andrew E. Douglass, and Charles J. Kullmer. Publication of the Carnegie Institution of Washington, No. 192. Pp. v+341. (1914.)

attain a high degree of definiteness. Discussions by C. J. Kullmer on the shift of the storm track, and by Charles Schuchert on climates of geologic time, complete the volume.

The memoir is written in Prof. Huntington's usual vigorous style, and is well illustrated with photographs, diagrams, and curves. In this connection it must be remarked that although the graphical method of comparison is very valuable, it would have been usefully supplemented in the case of the long series of comparable values by the calculation of correlation coefficients, which give a quantitative measure of the relationship. The vigorous American style, also, is apt to strike English ears harshly, as when on page 73 the author writes: "The present water supply . . . is almost negative, and the possibilities of agriculture still smaller." These, however, are very minor details, and in no way detract from the value of the memoir as a detailed comparative study of several lines of evidence bearing on a subject hitherto somewhat neglected.

NOTES.

THE London office of the British Association has learned from the officers of the Association in Australia that the overseas party has safely arrived, and that the meeting is proceeding in accordance with the original programme.

THE Meteorological Conference, which was to have taken place in Edinburgh in September, has had to be postponed. A further announcement respecting it will be made in due course.

THE International Seismological Congress, which was shortly to have been held at St. Petersburg, has been postponed.

IT was stated in our last issue (p. 590) that forms had been circulated by the British Association Committee for Radiotelegraphic Investigation for the use of those who will observe the forthcoming solar eclipse and who were prepared to make notes of "strays" and to record the measurement of the strength of signals, five high-power wireless telegraph stations in Europe having undertaken to make a series of special emissions during the eclipse. The outbreak of hostilities on the Continent will doubtless make it impossible for the programme of proposed emissions to be carried out, and intending recorders of the observations above referred to are therefore informed that the suggestions of the Committee cannot be carried into effect.

THE many friends of Prof. W. A. Bone will be distressed to learn of the death, on August 8, at a Leeds nursing home, of Mrs. Bone, which followed upon an operation. Prof. and Mrs. Bone with their family were on holiday at Burnsall, Wharfedale, when the necessity for the surgical operation referred to arose. Mrs. Bone took a deep interest in the progress of science, and subordinated all other considerations to the furtherance of her husband's scientific work. Prof. Bone will receive the respectful sympathy of his scientific friends, and past and present colleagues.

THE death is announced, in his eighty-third year, of Prof. F. Humphreys Storer, a distinguished American chemist. In 1853 he served as chemist to the U.S. North Pacific exploration expedition. After studying abroad, he spent several years in practising as a chemist at Boston. From 1865 to 1870 he was professor of general and industrial chemistry at the Massachusetts Institute of Technology, and from 1870 to 1907 he held the chair of agricultural chemistry at the Bussey Institution. He was the author of several text-books of chemistry, two of which were written in collaboration with Dr. C. W. Eliot, the ex-president of Harvard.

WE regret to notice the death, on Saturday last, at the age of forty-eight, of Sir Edward Anwyl, principal of the Monmouthshire Training College, and lately professor of Welsh and Comparative Philology at the University College of Wales, Aberystwyth.

IT is stated in the *Geographical Journal* that the Swedish Riksdag has voted to the Anglo-Swedish Antarctic Expedition the sum asked for, viz. 1500*l.* a year for five years, on condition that a similar amount is raised in England. Prof. O. Nodenskjöld will assume the leadership of the expedition for the first year and a half. The other members of the staff have not yet been chosen.

IT is stated in the *Morning Post* that in future the distribution of the Nobel prizes will take place on June 1 instead of in December, as hitherto. The next distribution has been fixed for June 1, 1915.

THE Earl of Londesborough and Mr. E. O. Sachs, of the British Fire Prevention Committee, have circulated a letter appealing for the names and addresses of qualified men prepared to enrol themselves as an emergency fire service force to be placed at the service of the Government for use in our fortified and defended places, our arsenals and national stores, and in certain Government establishments requiring special protection. Retired Fire Brigade officers and firemen —both professional, volunteer and private—and a limited number of Fire Brigade officers and firemen of inland (country) brigades, both volunteer and private, not exceeding three from any one brigade, are needed. It is also proposed to form a supplementary roll of young engineers (used to steam engines or motor-cars) and young surveyors or architects (used to building, survey, or dangerous structure works), who, although not having actual fire experience, would be valuable in an emergency fire service force. Applications for enrolment should be addressed to Lord Londesborough and Mr. Sachs at the offices of the British Fire Prevention Committee, 8 Waterloo Place, London, S.W.

THE current number of the *Geographical Journal* contains well-executed process plates of the memorial about to be erected to Captain Scott and the companions who perished with him in the Antarctic, and that of Dr. E. A. Wilson, which was unveiled at Cheltenham on July 8 by Sir Clements Markham. The design of the Scott memorial is the work of Mr. A. H. Hodge, and the general plan is as follows:—A granite pylon is surmounted by a bronze group representing courage sustained by patriotism, spurning fear, despair, and death, the figure courage being crowned by immortality. The front of the pylon bears the names of the five men, and portrait medallions, in bronze, occupy prominent positions on the monument. On the back are represented a pair of snowshoes, a replica of the cross erected on Observation Hill, and a wreath. Beneath is given an extract from Capt. Scott's last message. On the four sides of the base are bronze relief panels depicting the course of the expedition, under the headings "to strive," "to seek," "to find," "and not to yield." The Wilson memorial was designed by Lady Scott. It is in bronze 7 feet high, on a base of Portland stone, and represents the explorer in Polar dress in a natural attitude.

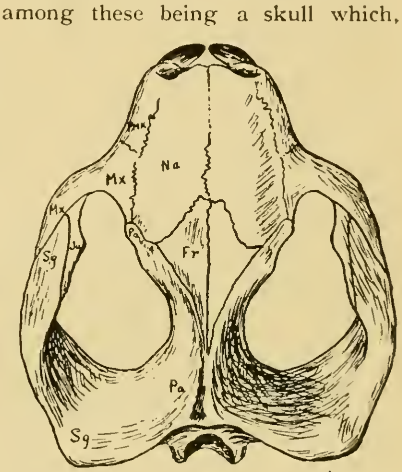
WE are asked to state that, in consequence of the war, the editorial duties in connection with the Gipsy Lore Society have been assumed, in collaboration, by the Rev. F. G. Ackerley, Grindleton Vicarage, near Clitheroe; Mr. E. O. Winstedt, Oxford; and Mr. A. Russell, Stromness. Members of the society are requested to address business communications to the first-named gentleman.

THE fifth report of the Royal Commission appointed to make an inventory of the ancient and historical monuments and constructions of Wales and Monmouthshire has just been issued. The inventories of Denbighshire are in the press, and will be issued in the course of the present year. The inspection of the monuments of Carmarthenshire has been completed, and the inventories are in preparation for the press. The volume on that county will be taken in hand immediately on the publication of that for Denbighshire. The inspection of the antiquities in the county of Merioneth is in progress, and will be concluded this year. Occasional reports are received of damage done to the monuments, as a rule to those of the prehistoric class, and, though the commission is powerless to exert active interference in such cases, endeavours are made to exert what influence is possessed by it in the best interests of the public.

THE July number of the *Journal of Anatomy and Physiology* contains three interesting embryological studies based on the construction of wax models. N. C. Rutherford points out certain resemblances between the fore-limb of the human embryo and that of the toothed whale and certain reptiles, suggestive of the fact that the history of the race is here repeated in the development of the individual. J. E. Frazer has investigated the development in the human embryo of the region of the internal and middle ear, while J. K. Milne Dickie has described the anatomy of the head end of a human embryo. The remaining articles are purely anatomical studies. Miss J. Meiklejohn gives an interesting series of illustrations demonstrating the position and relations of the groups of nerve cells in the heart of the rat. H. Blakeway's investigation on the anatomy of the palate is mainly of surgical interest, while that of D. E. Derry deals with a pathological perforation of the skull of an ancient Egyptian.

AN interesting feature in Captain S. S. Flower's report on the Giza Zoological Gardens for 1913 (included in the report on the Zoological Service for the same year, issued by the Ministry of Public Works, Egypt) is the reproduction of a photograph of a living Nubian ibex with the largest horns on record; the left horn measuring $51\frac{1}{2}$ and the right $50\frac{3}{4}$ inches, while the tip-to-tip interval is 35 inches. The enclosure of the two large paddocks for giraffes, together with the erection of the necessary buildings, has been completed, and the series of twenty-eight paddocks for antelopes were all but finished at the close of the year.

ALTHOUGH described by the late Prof. Cope so long ago as 1870, on the evidence of a fragmentary skull and teeth from the Puerco, or Lowest, Eocene of New Mexico, the genus Polymastodon, belonging to that group of early mammals known as the Multituberculata, has hitherto been very imperfectly known. A recent expedition dispatched by the American Museum to the Puerco beds of New Mexico was, however, fortunate enough to discover a number of remains of the genus, among these being a skull which, although much crushed and broken, was found to be capable of restoration. This unique specimen is described and figured in vol. xxxiii (pp. 115–134) of the Bull. Amer. Mus. Nat. Hist. by Dr. R. Broom, whose figure is here reproduced. In the general characters of its dentition and its relative shortness and breadth, the skull, which measures about 6 in. in length, distantly recalls that of a rodent; the dental formula being



Skull of *Polymaston taöensis*. *Fr*, frontal; *Ju*, jugal; *Mx*, maxilla; *Pa*, parietal; *Pmx*, premaxilla; *Sq*, squamosal.

$$i.\frac{2}{1},\ c.\frac{0}{0},\ p.+m.\frac{3}{3}.$$

Among its many peculiarities are the cutting-off, by means of processes of the parietals and nasals, of the frontals from the orbits, and the apparent absence of lachrymals. As regards the affinities of the multituberculates, Dr. Broom (in opposition to the opinion of Dr. Gidley, who, as recorded in NATURE in 1909, definitely included them in the marsupials) considers that these are with the monotremes (duck-billed platypus and echidna), a remarkable feature being that the Tertiary Polymastodon comes nearer to that group than does the South African Triassic Tritylodon. On the whole, it seems probable that mammals originated during the Trias from cynodont reptiles, and that from this original stock diverged at an early date a branch which gave rise to the multituberculates, and later, after considerable specialisation and degeneration, to monotremes.

An elaborate study of the auditory ossicles of American rodents has been made by Messrs. Cockerell, L. Miller, and M. Printz, in the hope that it might elucidate the taxonomy and origin of the order they represent. The work, which is published as article 28 of vol. xxxiii. of the Bulletin of the U.S. National Museum, has not, however, led to any very decisive result with regard to either point, Dr. W. D. Matthew remarking in an appendix that the frequent occurrence of parallelism and convergence is likely to be a bar to the taxonomic value of these structures. In reference to the suggestion that rodents are derived from the multituberculates, the same palæontologist, in a footnote, states that is an altogether untenable theory.

The *Daily Malta Chronicle* of July 22 records the stranding at Birzebbugia on July 20 of a "sea-monster." It measured 16½ ft. in length, was black in colour, and armed with eighteen pairs of teeth. Although referred to as a "cachelat," it was probably a blackfish (*Globicephala melaena*).

The August number of the *Selborne Magazine* contains that portion of the annual report of the Selborne Society for 1913, which deals with the natural history of the year. In the section on the protection of animals, it is recorded that the hawfinch nested—so far as known for the first time—in the Brent Valley bird-sanctuary.

The July number of the *Museums Journal* contains a photograph of the model of the skeleton of the early Tertiary Egyptian ungulate, *Arsinoëtherium zitteli*, to which attention was directed in our columns a few weeks ago. The Children's Museum at Olympia, which has been so admirably arranged, under conditions not altogether the most suitable, by Mr. W. Mark Webb, and the Wilton Park Museum, Batley, Yorks, form the subject of other articles in the same issue. The Wilton Park Museum does not restrict its scope to local subjects, one room being devoted to illustrations of life in Biblical lands.

In an appendix to a reprint of an article in the May number of *Zoologica*, it is stated that three of the school of bottle-nosed dolphins, or porpoises, in the New York Aquarium (to which reference has been already made in Nature) died early in June from tubercular pneumonia, and that the rest were suffering from ulceration of the skin, due to the low degree of saltness in the water of their pond.

In the February issue of Section D of the *Philippine Journal of Science* (vol. ix., No. 1) Mr. D. C. Worcester records the occurrence off the coast of Palawan of what is definitely asserted to be a flying crustacean. The creature was seen thrice by Mr. Worcester, and once by Mr. Schultze, and on this evidence, despite the fact that no capture was made, it is asserted that "there remains no doubt of the existence in the Philippines of a marine crustacean, from 15 to 25 centimetres in length, which has the power of rising rapidly from the water and flying, after the fashion of a flying-fish, for several rods." Articles by A. Seale on the preservation of food-fishes and other commercial fishery products in the tropics and on the fishes of Hong Kong, and a third, by Mr. Artemus Day, on the osteology of the Philippine "slime-head" (*Ophiocephalus striatus*), a fresh-water fish, are included in the same issue.

In the April number of the *Ann. Mag. Nat. Hist.* (8), vol. xiii., 1914, pp. 380–9, Prof. Chas. Chilton records the presence of the well-known wood-boring "gribble" (*Limnoria lignorum*) in Auckland Harbour, New Zealand. He believes that this isopod must been introduced into Antipodean waters many years ago in the timbers of some old wooden ship. In connection with this record, Prof. Chilton discusses the relationships of the six known species of Limnoria which are all closely related to each other, and describes in some detail *L. segnis*, a form indigenous in New Zealand seas, which does not bore into timber, but lives in seaweed. He regards the wood-boring habit as normal for the whole genus, and explains the wide distribution of the species as due to transport by floating logs. In a supplementary note he points out that Dr. W. M. Tattersall, in his account of some of the Crustacea of the *Scotia* expedition, records *L. lignorum* from the Falkland Islands. There is, however, a characteristic *L. antarctica*—a seaweed-borer like *L. segnis*—which lives off South Georgia, the South Orkneys, and the South Shetlands. It may be that these far southern members of the genus show, rather than our European "gribble," the primitive habit of the group.

The Clare Island Survey carried out by the Royal Irish Academy has published two further volumes: a full report on Archiannelida and Polychaeta, by R. Southern; and a paper on Tree-Growth, by A. C. Forbes. The latter reaches the conclusion that the absence of such trees as the ash, alder, and wych elm from the whole of the western islands suggests that these islands possess only the oldest representatives of the Irish forest flora, and were separated from the mainland at an early period. Pine and birch were the principal species at first, but oak and hazel followed, and gradually dominated the pine. The present treeless condition of the island is largely due to human agency, but there is reason to believe that the summers are cooler than when the oak was largely represented.

Miss Lillian S. Gibbs has contributed to the Journal of the Linnean Society (Bot., vol. xlii.) an extensive and valuable description of the flora and the plant associations of Mount Kinabulu and the highlands of British North Borneo. Although the coastal flora of the country had been well explored previously, the author has been able to add to the already known flora of Mount Kinabulu itself 129 new records; in all she collected about a thousand species, of which eighty-seven have proved new to science, including four new genera, while 337 species (comprising three new genera and thirty-eight new species) are referable to the mountain itself. The systematic account, which contains valuable notes on many of the species, is preceded by a detailed general description of the ecology and plant-geography of the area which the author has so strongly explored.

Dr. N. O. Holst supports Jamieson's theory of the subsidence of large areas under the weight of the ice-sheets of the Glacial epoch ("Le commencement et la fin de la période Glaciaire," *L'Anthropologie*, vol. xxiv., p. 353), and urges that glacial conditions are primarily due to elevation of the land. Such elevation defeats itself, as it were, since the spread of the ice soon causes a depression. The upward swing, after melting has occurred, may promote a further, but less important, glaciation, and when, on depression, this second series of ice-sheets melts, the Glacial epoch comes to an end. It must be remarked that the real difficulty of the isostatic theory of movements during an ice-age lies in the impossibility of saying how far these were complicated by crust-displacements of a more normal order.

Dr. J. v. Hann, in an article in the *Oesterreichisches Bäderbuch* on climatic factors from the balneological point of view, points out that existing statistics for health resorts only partially meet the requirements of medical men as regards information wanted for invalids. The subject is discussed under each element at considerable length, and the author's great authority in climatological matters lends additional weight to his views. We can only very briefly refer to a few of the points. *Air temperature*: the hours usually adopted require to be supplemented in some cases, and the mean dates given of the occurrence of certain temperatures in spring and autumn. The desirability of publishing "variability" of temperature (the difference of the mean from one day to the next), and possibly for different parts of the day is urged. *Wind*: references are made to experiments on the cooling effect of different wind forces, and to a useful instrument (homöotherm) lately devised for the purpose of determining the loss of heat due to wind. *Humidity*: Dr. v. Hann thinks that "relative humidity" is most suitable from a biological point of view; the readings of the wet-bulb thermometer (in conjunction with those of the dry-bulb) are also important. *Sunshine*: Mean duration is best shown by the ratio to the possible amount. Of other methods, that giving the mean daily duration is more convenient than that showing the total number of hours. *Fog*: the mean data as mostly published are misleading; the time of its occurrence is wanted. The second part of the article contains a general sketch on the climatic districts of Austria.

A recent publication of the Meteorological Office, "Hourly Values from Autographic Records, Geophysical Section, 1912," includes data meteorological, magnetic, and electrical. The meteorological data consist mainly of normal hourly values for each month of the year of barometric pressure, temperature, relative humidity, wind velocity, rainfall, and duration of bright sunshine at Aberdeen, Falmouth, Kew, and Valencia, and the differences from these normals observed in 1912. For Eskdalemuir, a recent station, the information is confined to 1912. At the end of the volume there are some notes by Mr. E. Gold on the principal meteorological phenomena, and some tables explanatory of the units (millibars, absolute temperatures, etc.) employed. The magnetic part gives hourly values of the north and west magnetic components at Eskdalemuir. The vertical force magnetograph, it is explained, did not give trustworthy results. There are also tables of diurnal inequalities from all days at Eskdalemuir, and from five "quiet" days a month at Kew and Falmouth. Other tables give inequality ranges, non-cyclic changes, Fourier coefficients for the diurnal variation and mean annual values of the magnetic elements. The electrical material bulks much less largely. It consists of mean monthly values and diurnal inequalities of potential gradient at Kew and Eskdalemuir. There are explanatory remarks and comments by the superintendents of Kew, Eskdalemuir, Falmouth, and Valencia Observatories, and a preface by the director of the Meteorological Office.

"The Seaman's Handbook of Meteorology," recently issued by the Meteorological Committee as a companion to the "Barometer Manual for the Use of Seamen," is, in fact, a general meteorological treatise covering to some extent the same ground as the "Observers' Handbook" (which is published annually for the use of observers at land stations), with the addition of special chapters on "Seamen's Weather," relating especially to wind, fog, and floating ice. It is intended to replace the "Fishery Barometer Manual" which has been issued for many years for use in connection with barometers lent to fishery stations and small seaports. The work has been carried out in a very satisfactory manner by Commander Campbell Hepworth, marine superintendent of the office. Full explanations, based on investigations of scientific men generally, and on Meteorological Office publications, are given, with frequent extracts, of the processes at work in the production of meteorological conditions. These are illustrated by excellent pictures of clouds, and by typical synoptic charts of high and low barometric pressure, some of which are supplemented since the time of original issue by data from wireless telegrams, so that the area westward has been much extended. The chapter on icebergs and other forms of drifting ice, not usually found in ordinary text-books, will be much appreciated by meteorologists generally. The handbook is accompanied by an instructive prefatory chapter by Dr. W. N. Shaw, on the old and modern aspects of maritime meteorology.

The Proceedings of the British Academy, vol. vi., contains an interesting article by Prof. Silvanus P. Thompson, on the "rose" of the winds and the origin and development of the compass card, which was read in April, 1913, at the International Historical Congress. It deals with the origin of the names of the winds, the letters denoting which appear on many of the older compass cards, also with the origin of the arrangement of the "rose" of 32 points, and with the distinctive marks on compass cards. A curious fact related by Prof. Thompson is that the fleur-de-lis, now in general use to denote the north, did not appear on compass cards prior to 1500. He thinks there is something to be said for the view recently advanced by Herr Schück that the device was originally intended to represent the primitive form of floating compass in which a lance-shaped needle was supported between two wooden floats. After a general review of the development of the compass card, Prof. Thompson gives a classification of the principal forms which appeared prior to 1600. Beautifully coloured illustrations appear in five of the six plates at the end of the paper. From an artistic point of view it is to be regretted that, as has been the case with ordinary male attire, colour has now disappeared from compass cards. At first almost universal, it seems to have died out before the end of the seventeenth century.

In the *Quarterly Review* for July, Mr. George Forbes, in a review of Sir David Gill's "History and Description of the Royal Observatory, Cape of Good Hope," gives a sympathetical account of the life and labours of "this great man, who will live in the hearts of all who knew him, not only as among the greatest of astronomers, but also as one of the noblest and most lovable of men." Special attention is naturally given to his work at Capetown between 1879 and 1907. The comments on his career by the most eminent astronomers of the day, included in this article, show the great scientific value of his work, and the impression left on his contemporaries by his unselfish devotion to science and by the nobility of his character.

Bulletin No. 11 of the Indian Association for the Cultivation of Science consists of three papers by Mr. C. V. Raman on the dynamics of vibration, which are well illustrated, and cover fifty-two pages. The first deals theoretically and experimentally with the vibrations of a silk thread attached at its two ends to the prongs of two tuning-forks of different periods the directions of motion of which are parallel to the string. If M and N are the frequencies of the forks, it is shown that the string will be set into vigorous transverse oscillation if the tension of the string is so adjusted that the natural period is nearly $\frac{1}{2}(Mm \pm Nn)$, where m and n are integers. The second deals in the same complete manner with the possible frequencies of oscillation or speeds of synchronous rotation of a soft iron wheel with thirty teeth mounted between the two poles of a small electromagnet fed by an alternating current of frequency 24 or 60 per second. The third describes new methods of studying the relation between the motion of the bow and that of the bowed point of the string it sets in motion, and of recording the motion of each point of the string. It appears from the author's observations that in all cases in which the displacement time curve of the bowed point is saw-toothed, the velocity of forward motion of the bowed point is identical with that of the bow.

The Government have taken over two battleships, one completed and the other shortly due for completion, which had been ordered in this country by the Turkish Government, also two destroyer leaders ordered by the Government of Chili. Reference is made to the battleship *Sultan Osman I.*, now H.M.S. *Agincourt*, in the paper read at the joint meeting of Naval Architects at Newcastle by Mr. J. R. Perrett, chief of the shipbuilding department at Elswick, where the ship was built. The vessel is 632 ft. long, with a beam of 89 ft. and a displacement of 27,500 tons. She carries fourteen 12-in. guns, twenty 6-in. guns, and a number of small guns. Her main armour belt is 9 in., and the upper belt 6 in. She has various armoured decks and extensive magazine protection. She is designed for a speed of 22 knots.

Messrs. Longmans and Co. have in preparation "The Year Book of Radiology for 1915." It is to be edited by Dr. R. Knox and J. H. Gardiner, and its object is to give an account of the more recent advances in our knowledge of radium, X-rays, and the allied phenomena, both from the medical and physical point of view. The volume will comprise a series of authoritative articles by specialists working in radiology, and a directory of qualified medical men practising in radiography, X-rays, radium and electro-therapeutics, both at home and abroad, also a list of hospitals and institutions where such treatment is carried out.

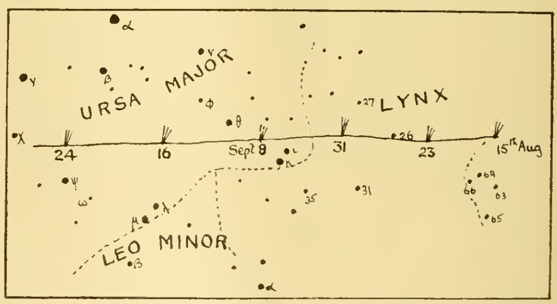
OUR ASTRONOMICAL COLUMN.

Comet 1913 *f* (Delavan).—The following ephemeris and chart give the positions of Delavan's comet for the remainder of the present month and September. This ephemeris is given by Dr. Crommelin in the July and August numbers of *Knowledge* :—

Greenwich, Midnight.

	R.A. h. m. s.	Dec. ° ′
Aug. 15	6 54 24	+43 44
23	7 31 14	46 22
31	8 15 43	48 35
Sept. 8	9 8 35	49 56
16	10 8 6	49 51
24	11 9 33	+47 56

During the present month the comet is travelling in the constellation of the Lynx, passing



then into Ursa Major. The best time for observation is the early hours of the morning, and Dr. Crommelin thinks "that the prospects are hopeful for this comet being an interesting spectacle in September and October. There is already no doubt that it will be visible to the naked eye."

The Perseids.—The progress of this shower up to and including August 10 was watched by Mr. Denning at Bristol, and he reports it as fairly active, though on August 10 the number seen was decidedly scanty.

The shower first gave intimation of its oncoming on July 14, and there has been a gradual increase since that date. On August 10 the radiant point was very exactly defined at $43° + 56°$. On nights when the position could be determined from a sufficient number of meteors it showed the usual displacement.

On July 27, at 10h. $58\frac{1}{2}$m., a fine meteor, brighter than first magnitude, was doubly observed by Miss Cook at Stowmarket and by Mr. Denning at Bristol. Its heights were from 85 to 56 miles from over Hailsham to Selsey Bill on the south coast. Its path extended over 49 miles at very swift speed.

On August 7, at 10h. 37m., a brilliant Perseid, giving a vivid flash and leaving a streak for ten seconds, was seen at Bristol. It shot from $286\frac{1}{2}° - 2\frac{1}{2}°$ to $280° - 13\frac{1}{2}°$, but no further observations of this fine object have yet been received. On the same night, at 10h. 10m. to 10h. 15m., a "mock moon," or Paraselene, was observed at the same altitude as the moon, and about 23° east of our satellite.

This year, moonlight has interfered with the character of the Perseid display in its earlier stages, but her lustre will not materially obscure the meteors at the period of their expected greatest frequency, on August 11 and 12, when a considerable number of observers will have been engaged in watching them if the weather was suitable.

A NEW SATELLITE TO JUPITER?—In the *Times* of August 8, it is stated that "a telegram has been received announcing the discovery of a tiny object near Jupiter, which appears to be a new satellite of the planet. The discovery was made photographically by Mr. Nicholson at the Lick Observatory, Mount Hamilton, California. He reports that the new body is still fainter than the eighth satellite, which is of the seventieth magnitude, and only about forty miles in diameter, so that it can only be observed with very large instruments." It is further stated that on July 21 the new body was 6m. 41s. west of Jupiter, and on July 24, 6m. 36s. W.

STELLAR RADIAL-VELOCITY OBSERVATIONS.—In 1908 Prof. Küstner published the results of the radial velocities of ninety-nine stars of the spectral types F to M, which he determined during the period 1903 to 1908 with the three-prism spectrograph of the 30 cm. Bonn refractor. The faintest star then photographed in two hours was of the magnitude 5·2. In *Astronomische Nachrichten,* No. 4750, he publishes the radial velocities of 227 stars of the spectral type F to M which he has determined during the period 1908 to 1913, with the same refractor. In this case a new spectrograph was employed in order to continue the work to fainter stars. At the conclusion of the individual observations he compares his values, where possible, with those obtained by Prof. Campbell at the Lick Observatory: the values for 151 stars are available, and he determines the mean differences of the observed radial velocities, Lick minus Bonn, for each spectral class. These differences he regards as errors of the Bonn observations, taking into account the better observing conditions and more efficient instruments available at the Lick Observatory. Mr. J. H. Moore publishes in the Lick Observatory Bulletin, No. 257, the observations of seventeen stars the radial velocities of which vary, and also those of two stars which have large and apparent constant radial velocities. These stars are AGC 7165 and ω Pavonis of magnitudes 5·2 and 5·1 respectively. They belong to the spectral classes G and K, and the velocities derived were +184·8 and +184·4 kilometres a second respectively.

THE SOLAR ECLIPSE.—The *Times* announces that a telegram has been received from Major E. H. Hills, president of the Royal Astronomical Society, stating that he and Prof. A. Fowler, who had intended going to Kieff for the purpose of observing the solar eclipse, have abandoned their project, and are on their way to St. Petersburg.

SOUTH AFRICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE twelfth annual session of the South African Association for the Advancement of Science was held in Kimberley, Cape Province, during the week commencing Monday, July 6, under the presidency of Prof. R. Marloth. There was the usual round of festivities and of visits to places of scientific or historic interest. The association meets in four sections, but in view of the increasing interest of matters pertaining to South African native races, Section D resolved to establish a subsection for African ethnology, education, history, language, and native affairs before next year's meeting in Pretoria is held.

The papers read numbered between forty and fifty, and brief outlines of the four sectional presidential addresses and some of the papers contributed by members are given below.

Dr. A. Ogg, professor of physics at Rhodes University College, Grahamstown, in his presidential address to Section A, dealt with some of the ideas in physical science which are under discussion at the present time in the light of recent research, and sought to bring under review some of our fundamental notions or principles, having regard to the fact that what mathematicians and physicists have long considered well established is now being uprooted and replaced by non-Newtonian mechanics based on the principle of relativity. Shape and mass, in fact, are looked upon as functions of velocity. Scientific thought, Prof. Ogg described as so plastic nowadays that the most cherished tenets of the last generation of men of science are being abandoned, and the greatest danger is that the meaning of the involved consequences is not always realised. As to the true physical meaning of the new ideas propounded there is much speculation, and many hold such speculations to be beyond the true scope of science. Quoting Schuster, in conclusion, Prof. Ogg said that all preferred being right to being wrong, but it is better to be wrong than to be neither right nor wrong.

In Section B the presidential address was given by Prof. G. H. Stanley, of the Transvaal School of Mines and Technology, whose subject was "A Decade of Metallurgical Progress on the Witwatersrand." The greatest advances during the last ten years, he said, were in improving methods of carrying out the various stages of the extraction processes, the essentials remaining unchanged. Sorting tables, for example, had been replaced by travelling belts, which were also elevators. Amalgamation is now carried out by flowing the tube-mill product over stationary plates, shaking plates having been discarded. Slime is now being treated more cheaply than sand; classification had greatly improved, and this, together with finer grinding, ensured that the sand residue after cyaniding contained only 0·2 of a dwt. of gold per ton. For slime treatment filtering methods were now sometimes employed, giving higher gold extraction and increased profits. Working costs had been brought as low as 3s. per ton.

In Section C, comprising the biological sciences and agriculture, the presidential address of Prof. George Potts, of Grey University College, Bloemfontein, dealt with rural education. South Africa, except the Rand and some coast towns, Dr. Potts pointed out, is essentially rural, and inland towns depended on the surrounding pastoral population. All grades of education should therefore be made adaptable to a rural people. The following reforms were advised:—(1) More representation for agriculture and the natural sciences on the University Council; (2) encouragement of the study of natural science in university colleges; (3) appointment of additional school inspectors specially qualified to deal with nature-study and science teaching; (4) more teaching of nature-study, school gardening, botany, and zoology at the training colleges; (5) a more liberal matriculation, allowing of two natural sciences alternatively to Latin and mathematics; (6) more biology in secondary schools; and (7) systematic and correlated nature-study and school gardening in the primary schools.

Prof. W. Ritchie, of the South African College, and Vice-Chancellor of the University of the Cape of Good Hope, presided over Section D, and in his inaugural address discussed "Some Aspects of Language Study." Comparing the science of language with the other branches of natural science, he showed the disadvantage of the former in that it lacks actual objects capable of being handled and experimented with. The spoken word perishes, and cannot be retained as a labelled specimen for investigation at leisure, so that the student of a thousand years hence, with no data regarding the English language save its written symbols, would be unable to reconstruct from these the exact vocal sounds which they represent for us. Fortunately specimens of vocal sounds may now be stored away for reference by means of the gramophone, and even the records now being produced for mere amusement may thus aid the objects of science. Some European countries already possess large collections of records showing distinctive features of various dialects, and it may be feasible with every census of population thus to provide for a census of language. In South Africa there is an amazingly wide field open for investigation; in English, with its varieties of local intonation; in Dutch with its three recognised forms; and in the numerous native languages, in regard to which an endless amount of work yet remains undone. The institution of a chair of phonetics was therefore suggested, and next in importance would be chairs for the systematic study of the country's aboriginal languages. Then chairs of ethnology should be added, and all this calls for speedy attention, as witness the opportunities passing, never to be recalled, with the fast disappearing Hottentots and their curious and interesting language and ethnological connections.

Of the papers read at the sectional meetings, in Section A a great deal of interest attached to a series of spectrographic investigations of the N'Kandhla meteorite and other meteoric irons by Dr. J. Lunt, of the Royal Observatory, near Cape Town. Several measurements of wave-lengths demonstrated that the lines observed were yielded by cobalt, nickel, chromium, iron, and barium. No evidence was found of the presence of magnesium, platinum, or copper. Mr. E. Jacot contributed the results of experiments made at the South African College with respect to atmospheric radio-activity. The activity of a wire charged with a high negative potential was least after rain and highest after S.E. winds. Per unit volume of air there was 28,000 times as much of the emanation of radium as of thorium.

In Section B Dr. W. Johnson contributed a paper embodying further experiments made by him in regard to the origin and formation of the diamond, which, he is convinced, could not possibly have taken place in a rock in molten condition. "The lost land of Agulhas" was the subject of a paper by Prof. E. H. L. Schwarz, whose theory is that the flagstones and clay slates of the Cape Peninsula were formed by denudation from a now submerged land to the south of the present continent. Four papers on geological subjects were submitted by Dr. W. Versfeld, the most important of which was one which recently gained him his doctorate from the Cape University—"The Geological Structure of Parts of German South-West Africa." Dr. C. F. Juritz read a paper on the investigation of plant poisons in South Africa, detailing the results of numerous analyses, many of which indicate active principles new to science. The great importance of systematically investigating this subject was urged. Another instructive paper, by Mr. C. Williams, dealt with the chemical control of cattle-dipping tanks.

The Rev. J. A. Winter contributed to Section C a suggestive paper on native medicines, and urged that the Agricultural Department should devote its attention to the indigenous plant remedies employed by "Kaffir doctors." Dr. Perold and Mr. Crawford contributed a comprehensive series of analyses of vineyard soils from the Montagu and Robertson districts. Mr. F. W. FitzSimons detailed the results of experiments with banana stem juice and other alleged snake-bite remedies, all of which failed to produce the curative effects ascribed to them.

Several papers in Section D were devoted to native manners and customs. The Rev. W. A. Norton dealt with the study of the South African native languages, and in the course of his address he pleaded earnestly for a scientific study of comparative Bantu. Miss Wilman exhibited a magnificent collection of actual-size reproductions of Bushman paintings and rock engravings. The Rev. J. R. L. Kingon, of the U.F.C. Mission, Somerville, contributed a paper on the emergence and progress of the Transkeian natives, ascribing to the passing of communal land tenure, *inter alia*, the vast change that was taking place. He emphasised the desirability of instituting individual tenure, so that economic pressure, supplemented by the establishment of a native university, might complete the improvement in the status of the natives who were being rapidly Christianised. The Rev. Noel Roberts submitted a paper on the practice of the To-Kolo system of divination amongst the natives of the northern Transvaal, and a contribution by Mr. H. W. Garbutt on the resemblance between the utensils of the ancient Egyptians and those found in Northern Rhodesia was likewise of great interest. Mr. Garbutt also contributed some notes on the natives of Rhodesia. "The mental and moral capacity of our natives" was exhaustively dealt with by the Rev. J. A. Winter, who has resided for fifty years amongst the natives of eastern Transvaal.

Other papers of interest read in Section D included suggestions for the constitution of an Upper House of Parliament, by Dr. A. H. Watkins, the main suggestion being that admission to the franchise be restricted to persons of advanced years. A valuable paper on South African place-names was read by the Rev. Charles Pettman, and one equally valuable, although in a totally different sphere, was given by Dr. T. B. Muller on some defects common to epistemological idealism and realism.

An evening discourse was delivered in the Kimberley City Hall on Friday, July 10, by Prof. E. H. L. Schwarz, on the Kimberley diamond pipes, the history of their discovery, and their relation to other South African volcanic vents. This lecture, like Prof. Marloth's address as president of the Association on Wednesday, July 8, was illustrated by many lantern slides. The numerous slides exhibited by Prof. Marloth were all exquisitely hand-coloured, and constituted without doubt the most excellent collection representative of South African indigenous flora ever exhibited. They were specially prepared by Dr. Marloth for this occasion. At the conclusion of the president's address, Dr. Crawford, the association's senior vice-president, handed to him the South Africa medal (instituted by the British Association in 1905 in commemoration of its visit to South Africa during that year) and grant of 50*l*. which had been conferred upon him in recognition of his eminent services to botanical science in South Africa during the last thirty years.

C. F. J.

THE MUSEUMS ASSOCIATION.

SWANSEA CONFERENCE, JULY, 1914.

THE Museums Association fittingly celebrated the completion of a quarter of a century's existence by an incursion into a hitherto unvisited country—the Principality of Wales—Swansea being chosen as the meeting place.

The attendance was very large, and the papers and discussions reached a high standard of excellence. Particularly noteworthy were those dealing in a practical way with the preservation and restoration of works of art—a subject which has never previously received so much attention at an annual conference.

Representatives were sent by forty provincial museums and art galleries, five national museums (the British Museum, the British Museum of Natural History, the Victoria and Albert Museum, the National Museum of Wales, and the Museum of the Royal Botanic Gardens at Kew), and the London County Council.

The presidential chair was occupied by Mr. Charles Madeley, Director of the Warrington Municipal Museum.

In his presidential address Mr. Madeley invited the conference to consider "What is the true theory of a municipal museum?" To the community which desires to establish or to re-organise a museum, this is a vital question, and the president dealt with it in a manner at once comprehensive and illuminating. Municipal museums are mercifully free from any kind of departmental regulations restricting their scope and activities, but this blessing has in the past been a somewhat mixed one, and one of the great functions of The Museums Association is to see that it is henceforth properly appreciated.

The president suggested that a museum might be defined as "a collection of specimens *arranged with a purpose*," and objected to that purpose being defined as "educational," by reason of the unattractive nature of the word and the unnecessary limitations imposed by it. This objection was the source of some misunderstanding on the part of those hearers who did not grasp the true significance of Mr. Madeley's remarks, although he made it abundantly clear that a museum must, in his view, be educational. The contents of the ideal museum should, according to the president, constitute a miniature or synopsis of the universe—the true microcosm, in fact—but with the great and essential difference that, in the museum, things are classified, and therefore intelligible, whilst in the world outside they are not. He quoted with approval the statement of Dr. Brown Goode that a museum should be "an institution for the preservation of those objects which best illustrate the phenomena of nature and the works of man, and the utilisation of these for the increase of knowledge and for the culture and enlightenment of the people."

The text being thus provided, there arises the necessity for a full and sound classification of the whole of the possible contents of such a museum.

Classifications, which might be thought suitable by some, have been prepared for the use of librarians, but the president pointed out that these are too arbitrary. In a library, where classification exists merely to promote ease of reference, this does not matter, but an orderly and logical conspectus is absolutely necessary when one of the great properties of the institution is "visualisation," as in the case of museums.

A filling-out of the broad scheme, drawn up by Brown Goode, is the kind of thing required. In it different points of view would be provided for, and the president called attention to one which has long suffered under an unjust stigma—namely, the economic point of view. "We may hope," said he, "that technology, and eventually even commerce, may meet with adequate recognition in the museum."

Mr. W. Grant Murray, Director of Art in Swansea, then gave an interesting account of the rise of the school of art and crafts and of the two local art galleries.

Dr. H. Langton related some of his experiences in the preparation of the skulls of birds by means of the sand-process. His remarks brought forth a champion of the old water-maceration method, in the person of Mr. A. W. Gunn, of Newport, and it seemed fairly obvious from the discussion that, as in most matters, there is no one universally applicable method.

Mr. B. H. Mullen gave an account of the "Children's room" at the Salford Museum, which has been established with the intention of providing a series of introductions to the various major collections, and to bring young people into intelligent and sympathetic touch with them.

The Bankfield Museum publications were the subject of a note by the curator, Mr. H. Ling Roth.

On the evening of Tuesday, July 7, Mr. E. Rimbault Dibdin, curator of the Walker Art Gallery, Liverpool, delivered a public lecture on "Wales and the Fine Arts, Past, Present, and Future."

Mr. E. Howarth opened a discussion on the subject of "The Museum and the Schools," in which he emphasised the great desirability of these rapidly developing institutions keeping in close touch. There should be greater collaboration between the curator and the teacher in order that the curator's work may be of a nature to deserve and receive a full measure of use and appreciation by members of the scholastic profession and their charges. Mr. Howarth alluded to the importance of the kinematograph as a force in school teaching, and, as it is scarcely possible to have a kinematograph in every school, he suggested that every municipal museum might usefully instal an instrument to exhibit films germane to the work of the institution.

A demonstration of the characteristics—colour, translucency, etc.—of the various types of porcelain formerly made in Swansea and neighbourhood was given by Mr. Herbert Eccles.

Mr. Quick, under the title "The Protection and Restoration of Pictures," gave a number of hints on the care and treatment of paintings, drawings, and engravings.

Mr. Williams's paper on "The Renovation and Restoration of Oil-paintings, with Practical Experiments," was illustrated by some examples of "before and after" treatment.

Dr. H. S. Harrison, of the Horniman Museum, in a paper entitled "Ethnographical Collections and their Arrangement," advised the adoption of what has been described as the "topical" mode of arrangement, and showed by means of well-chosen lantern slides how the evolution of processes, utensils, instruments, etc., might be advantageously illustrated.

Some points in the construction and fittings of the new King Edward VII. galleries at the British Museum were described by Mr. R. A. Smith.

The final paper was one in which there was every evidence of a serious premeditated intention to fit a museum building for the purpose of adequately and comfortably displaying the objects to be housed in it. We refer to the design for the new museum and art gallery at Belfast, which was lucidly described by Mr. Arthur Deane. Here the curator and architect have evidently been in close collaboration, and have produced a design original in several features and full of promise.

The entertainment and hospitality meted out to the Association by the Mayor and Corporation of Swansea and the leading citizens were of a most lavish and thoroughly enjoyable character, and the local arrangements were carried out by Mr. W. Grant Murray with a smoothness and precision which have never been surpassed.

The Association, at its business meeting, elected a distinguished worker on the art side—Mr. E. Rimbault Dibdin—to be president for 1914–15.

THE HARDENING OF STEEL.

AT the May meeting of the Iron and Steel Institute two papers were read and discussed dealing with the theory of the hardening of steel; they gave rise to one of the most interesting discussions of the meeting. While it is, of course, obvious that the more "practical" members of the institute take no interest in these discussions, it must be borne in mind that the theories of to-day become the foundations of the practice of to-morrow, and that therefore the "practical" man cannot in the least afford to despise or ignore what he likes to dismiss as "mere theory."

The two papers on hardening presented to the institute both put forward fairly definite theories, and at first sight these differ entirely from one another and still more from the older purely "allotropic" theory of hardening. It was interesting to find, however, that during the discussion not a single advocate of the other older theory—that of the so-called "carbonists"—came forward. When the views put forward by Profs. Edwards and Carpenter and by Mr. McCance are carefully compared, however, it will be found that they do not really differ very vitally either from one another or from the older allotropic view. All three theories agree in supposing that when carbon steel is cooled rapidly an essentially unstable transition product is formed which is itself intrinsically hard. The allotropic theory called this intermediate hard product "beta iron," and identified it with the beta iron which has a limited range of stable existence in pure iron and in low-carbon steels; Messrs. Edwards and Carpenter and the writer now identify it with the "hard amorphous phase" of Beilby, while Mr. McCance invents a new word and calls it "interstrained" iron. The real difference of opinion seems to centre on the question how this intermediate substance comes into existence.

Profs. Edwards and Carpenter approach the subject from the point of view of an analogy between the hardening by quenching of steel and of alloys of copper containing from 10 to 13 per cent. of aluminium. These latter are somewhat hardened by quenching, and there is a corresponding similarity, on broad lines, between the respective constitutional diagrams; by quenching, both kinds of alloys are caused to pass rapidly through a transformation range. The resulting micro-structures also show a certain similarity, the aluminium-copper alloys exhibiting an acicular structure having some resemblance to the coarser kinds of martensite seen in hardened steels. The authors then endeavour to show that the structures of both quenched aluminium-copper alloys and of quenched steel arise from an identical cause, viz., highly multiplied twinning, which they believe to occur during quenching as a result of the internal strains caused during rapid cooling. The evidence that the martensite of steel is really equivalent to highly twinned austenite is, however, very weak, and it has yet to be proved or even shown to be likely that quenching can produce multiple twinning. In the discussion of this paper, the writer pointed out that to produce notable strain-hardening of a plastic metal by deformation needed the application of really large deformations, while, on the contrary, the amount of deformation (*strain* in contradistinction to internal *stress*) which could be caused in steel by quenching must be very small. It is further a very open question whether strain really ever produces direct twinning in a metal. Finally, it has yet to be shown that a twinned constituent is really materially harder than in the untwinned condition; the softness and ductility of such materials as rolled and annealed copper or brass, which are one mass of twinned crystals, points in the opposite direction. The idea put forward by Edwards and Carpenter that amorphous layers are formed on the twin boundaries in the process of twinning was well refuted by Mr. Humfrey in the discussion, as he showed by means of models that twinning could and did occur without disarrangement of the space-lattice at the boundary. As a result of the whole discussion it appeared that the authors had attached altogether too much weight to the process of twinning, but that the formation of amorphous metal during the quenching process might well be looked upon as the real cause of hardening—a view which the late F. Osmond had put forward quite clearly a year or so before his death.

Mr. McCance's paper began a thoughtful consideration of the whole subject by a review of existing theories. Both in regard to the existence or otherwise of beta iron as an independent allotropic modification, and in regard to the amorphous theory, however, the author made the mistake of considering that the objections which he raised can settle the point and dispose of these theories in half a dozen words. The question as to the extent and nature of the differences between alpha and beta iron is still being closely discussed, and even if Weiss's magneton theory finds ultimate acceptance, it is still a question whether the magnetic transformations do not really constitute one type of allotropy, nor is it yet certain that they may not be associated with far-reaching changes in other properties. Again, as regards the amorphous theory, Mr. McCance's objections are based on a simple misunderstanding, coupled with an assumption, based on the magneton theory, which has yet to be justified. This assumption amounts to the view that only crystalline solids can be ferro-magnetic, and that consequently amorphous iron would necessarily be non-magnetic. Facts are, however, against this view, for colloidal suspensions of iron are strongly ferro-magnetic, and so are a number of oxides and salts of iron, some of the latter even in a state of solution.

Of much greater value are Mr. McCance's experimental studies of hardening in carbon steel, which lead him, finally, to put forward a theory of the hardening of steel by "interstrain," which is practically a translation of Osmond's view ascribing the hardness of quenched steel to the presence in it of "le fer alpha écroui." It is only Mr. McCance's account of the nature of "interstrained" iron which it is difficult to accept. Declining to accept the views of Beilby and of Rosenhain as to the hardening of strained metals by the formation of layers of the amorphous phase, the author uses the word "interstrain" to denote a condition in which the regular crystalline arrangement is broken up generally, leaving a mass of irregularly arranged crystal fragments. It may well be asked what it is that holds these irregular and ill-fitting fragments together, and why an aggregate of such fragments should be harder than the aggregate of the larger pieces of crystal which constitute the ordinary soft metal? But beyond this there is the experimental evidence; both strain-hardened metal and quenched steel on etching exhibit the well-defined oriented lustre of a crystalline aggregate, thus clearly showing that the crystals are not disarranged into minute irregular fragments. It would seem, therefore, that Mr. McCance's conclusions must be narrowed down to this, that the hardness of quenched steel is due to the same cause as the hardness of strain-hardened iron, and this—but for a difference as to mode of origin—is also the view of Edwards and Carpenter. In this narrowed conclusion, however, there is a distinct step forward, since we have a definite "explanation" of the hardening of steel in the sense that this phenomenon is correlated with the much larger class of phenomena which occur when any soft or ductile metal is hardened by plastic strain. If we accept the possible existence of the amorphous phase, it is easy to express both classes of facts in a single and simple formula, and this in itself constitutes another argument in support of the amorphous theory. Whatever view one may take of these admittedly hypothetical matters, it seems that a definite advance has at last been made in our knowledge of the hardening of metals.

W. ROSENHAIN.

SCHOOLS AND EMPLOYERS IN THE UNITED STATES.[1]

MISS WINEFRID JEVONS gives in the report before us an interesting account of the history and present position of the relations between the schools and industrial employment in the United States.

The most important lesson to be learnt from the report is, perhaps, that in the United States employers and trade unions have realised, to a much greater extent than in this country, the necessity for part-time day classes for persons engaged in industry and commerce. Not only does the American Confederation of Labour take this view, but the National Association of Manufacturers also favours it. Indeed, the latter body went so far in 1912 as to recommend compulsory continuation classes, until the seventeenth or eighteenth year, one half-day a week, without loss of wages.

In this country there are some firms (comparatively few in number) who have had the wisdom to see that it is not only in the interest of the people they employ but also in their own interest to liberate young persons a certain number of hours a week, in order that they may in the daytime receive proper part-time instruction directed to make them more efficient in their respective industries; but we are still far from so wide and generous a belief in the value of education as the resolutions of the National Association of Manufacturers show to be prevalent in the United States.

The existence of such a wholesome state of public opinion accounts for the large amount of voluntary and compulsory part-time instruction which is to be found throughout the States; many instances of this are given in the report. In Massachusetts, a law has been enacted which enables local authorities to open day continuation classes for the education of children between fourteen and sixteen who are in regular employment, and to compel attendance at these classes in the daytime for not fewer than four hours a week; the time spent in the school is counted as a part of the number of hours that the child is permitted by law to work. The State provides half of the cost of the maintenance of the classes.

In the States of Ohio and Wisconsin, compulsory day continuation classes are in existence; in the latter State, apprentices may not be employed for more than 55 hours a week, and the employer must liberate the apprentice five of these 55 hours a week in order that he may attend a day continuation school.

J. W.

[1] Board of Education. Special Reports on Educational Subjects, vol. xxviii.

SEISMOMETRY AND ENGINEERING.[1]

IN the memoir before us we have a gratifying proof that practical engineers realise the importance of the application of the principles of instrumental seismometry to building construction. The immediate object in the present investigation is the vibration set up in a large masonry bounding wall of a reservoir in Queistal, Schleswig. This wall stretches between rocks across a narrow valley, and the overflow of water, estimated at 100 cubic metres a second, falls about 40 metres. Thus an enormous amount of vibrational energy is set up.

The destructive action of vibration on a structure is probably determined by the maximum acceleration experienced, and thus short-period vibrations are often more serious than long-period vibrations of larger amplitude. Prof. Grunmach first describes and discusses an apparatus designed to give the maximum acceleration, and then goes on to describe the arrangements for investigating the period and amplitude. These are really seismographs for measuring the horizontal and vertical components of motion. They are based on precisely the principle of electromagnetic registration introduced by Prince Galitzin for earthquake recording. The apparatus differs from Galitzin's in detail considerably, since the periods and amplitudes to be measured are very different from those experienced by the passage of earthquake waves. Continuous registration was made, and excellent diagrams of the results are given. It appears that the periods ranged from about 0·03 sec. to 0·003 sec., and the amplitude from 0·001 mm. to 0·00005 mm.

The theoretical discussion of electromagnetic registration given appears somewhat inadequate. The author adopts what may be called an equilibrium theory instead of a dynamical one. It is possible that this may be accurate enough in the case considered, but one would like a demonstration that this is so.

The memoir will no doubt be appreciated by engineers and seismologists alike. G. W. W.

RECENT BOTANICAL WORK IN DENMARK.

AT the general meeting of the Danish Botanical Society in 1912 it was decided to publish in the future two distinct journals. One of these is the *Botanisk Tidsskrift*, the society's old periodical, which has reached its thirty-third volume, and contains chiefly papers on the Danish flora, besides articles on subjects of more general botanical interest. This will continue on its former lines, being written mostly in Danish, though occasionally—much too rarely, it may be said, for non-Danish readers—with abstracts in English, French, or German. The second journal is a new venture, the *Dansk Botanisk Arkiv*, published at indefinite periods, and containing monographs and other special articles in either of the four languages mentioned. Both journals are sent post free to members of the society, membership being open to all on payment of 10 kronen (11*s.*) a year; the subscription for the *Botanisk Tidsskrift* alone is 6 kronen, and the numbers of the *Arkiv* may be pur-

[1] "Experimentaluntersuchung zur Messung von Erderschütterungen. By Prof. L. Grunmach. Pp. 102. (Berlin: Leonhard Simion Nf., 1913.

chased separately. We have received from the society copies of the 1913 numbers of the new journal, and some of those of the old one, besides two reprints from the *Mindeskrift for Japetus Steenstrup*, published in 1913 and 1914.

These publications form sufficient testimony to the high standard of excellence maintained by the large output of papers by Danish botanists. The mantle of the distinguished veteran of Danish botany, Prof. Eugene Warming, has fallen upon the shoulders of C. Raunkiaer, who two years ago succeeded Warming as professor of botany in the University, and director of the Botanic Garden and Museum at Copenhagen, and who has already, like his predecessor, done brilliant work on the ecology of plants. In the 1913 *Tidsskrift*, Raunkiaer has a long paper on the plant ecology of the Skagen district, in which he applies his system of "life-forms" to the statistical study of the various plant communities. An account of Raunkiaer's methods of ecological study was given by Dr. W. G. Smith in the *Journal of Ecology*, vol. i., 1913, pp. 16–26, in which the value of Raunkiaer's system was pointed out. Ecology bulks largely in this, as in former volumes of the *Tidsskrift*, but while the Danish botanists have done so much for this department of the science they have by no means neglected other branches. Their systematic investigation of the flora of the Danish West Indies has yielded a large and valuable series of monographs, while they have done more detailed and intensive work on the vegetation of Denmark than has yet been carried out in any other area of similar extent, and the work of Ostenfeld, Borgesen, Paulsen, and others on the marine vegetation of the northern seas, and on the plankton in particular, is too well known to botanists generally to need more than passing mention here.

The first four parts of the new journal are occupied respectively by a list, in Danish with Latin diagnoses, of diatoms collected by Borgesen in the Danish West Indies; an account in English of the growth-forms of some plant formations of Swedish Lapland, by M. Vahl, who proposes a system of ecological nomenclature for plant formations according to the dominant growth-forms distinguished by Raunkiaer (a summary of Vahl's useful paper is given in *Journal of Ecology*, vol. i., pp. 304–6); a long paper in Danish on the ecology of lichens, with 240 illustrations, by O. Galloe, unfortunately without a summary in another language; and a valuable monograph of the marine algæ (part i., Chlorophyceæ) of the Danish West Indies, in English, and with a chart and 126 fine illustrations, by F. Borgesen. The last-named (Bind i., No. 4, price 4 kronen) is of much more than merely systematic or algological importance, for Borgesen devotes 146 of his 158 pages to detailed descriptions of the Siphoneæ, a group of algæ of peculiar morphological and biological interest, and exhibiting the extraordinary complexity of form and structure attained by plants which are built up of cœnocytic or incompletely septate filaments.

With these four papers the *Dansk Botanisk Arkiv* has certainly made an excellent beginning, and the only criticism that occurs to an English botanist is that *all* papers written in Danish should be furnished with a generous summary in English or French or German. In this connection one may remark that despite all that has been written and said concerning the advisability of the use of one or other of the three most widely read languages in scientific literature, pending the arrival of the golden age of one universal speech, there is apparently an increasing rather than diminishing tendency for scientific workers in the smaller countries, or those whose language is little known outside their own frontiers, to publish in their own tongue.

There are, of course, many sides to this question, local patriotism and other considerations having to be taken into account, but it is certainly inconvenient and often exasperating to come across publications in languages such as Russian, Czech, the Scandinavian tongues, etc., with either the baldest summary, or in many cases none at all, in the more widely read languages. Life is too short for the acquisition of even a fair working knowledge of so many tongues; summaries or reviews in the familiar languages may or may not be published sooner or later in the *Centralblatt* journals, and are often very meagre indeed; and meanwhile one hesitates to take the thing to a translator—it may prove of no special importance for one's purpose after one has taken the trouble or expense involved. The remedy is simple enough: a scientific worker whose native language is not English, French, or German, should take the trouble to master one or other of these languages sufficient to be able to append a good summary to his paper. Failing this, a reversion to the old custom of publishing in Latin might be advocated.

The two reprints from the J. Steenstrup memorial volume are devoted to accounts of the species of Sargassum found on the coasts of the Danish West Indies, with remarks upon the floating forms of the Sargasso Sea, by Borgesen, in English; and of the distribution and reproduction of the common eel-grass or grass-wrack (*Zostera marina*) in Danish seas, by Petersen, in Danish. F. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The war will have a serious effect upon the University during the coming session. The whole of the new buildings at Edgbaston have been taken over by the War Office, and now form the First Southern General Hospital. Certain structural alterations are being carried out with a view of making the hospital as efficient as possible. The size and situation of the buildings and grounds, and their proximity to railway and canal, render them especially suitable for the present purpose.

CAMBRIDGE.—Mr. W. L. Bragg, son of Prof. W. H. Bragg, has been elected to a fellowship at Trinity College. He gained first-class honours in the Natural Science Tripos, with distinction in physiology.

A SCHOOL of public health is to be established at the University of Minnesota.

DR. T. SHENNAN, pathologist to the Royal Infirmary of Edinburgh, has been appointed Regius professor of pathology in the University of Aberdeen, in the place of the late Prof. G. Dean.

THE new session of the medical faculty of the University of Manchester will be opened on October 8 by an address by Prof. E. S. Reynolds on the industrial diseases of Greater Manchester.

THE Bissett-Hawkins memorial medal of the Royal College of Physicians of London has been awarded to Sir Ronald Ross, for his work in connection with malaria, and the Sir Gilbert Blane medal of the Royal College of Surgeons of England has been awarded to Surgeon G. F. Syms, R.N.

IT is announced in *Science* that Prof. C. H. Eigenmann has been appointed research professor of zoology in the Indiana University, and that he proposes to devote the greater part of the time at his disposal in completing his studies of the distribution of the fishes of western Ecuador and western Colombia and its bearing of this on the east and west slope fauna of Panama. He intends to spend the coming winter months in correlating the fresh-water fauna of the lesser Antilles to that of South America.

THE Board of Education has issued (Cd. 7535) a new edition of its building regulations for secondary schools, being principles to be observed in planning and fitting up new buildings in England. The last issue was made in 1907, and experience has shown that a fresh statement of principles and of their application is required. The principal modifications in the present issue relate to the position of the assembly hall in relation to the class-rooms, the need of making provision for physical training in every new school, the arrangement of cloak-rooms, and certain details in connection with art and science rooms, housecraft rooms, and staircases.

THE prospectus of the university courses in the Municipal School of Technology, Manchester, for the forthcoming session has been received. It will be remembered that the Manchester Technical School forms part of the Victoria University of Manchester, and provides for the faculty of technology. The courses described in the prospectus lead to the degrees of Bachelor and Master of Technical Science. These courses are controlled by the Senate of the University, through the board of the faculty of technology, which is composed of the heads of departments in the school of technology together with certain other professors and lecturers in the University. The degrees may be taken in the following divisions of technology: mechanical, electrical, or sanitary engineering; applied chemistry; mining; architecture; and textile industries. Courses of post-graduate and specialised study and research have been arranged for students who have graduated.

AN interim report of the Joint Committee of the Illuminating Engineering Society and other bodies on "The Natural Lighting of Schools" appeared in the July number of *The Illuminating Engineer*. Among the suggestions we note:—(1) No place is fit for use in a schoolroom when diamond type cannot be read easily by a normal observer at a distance of half a metre; (2) the darkest desk should receive not less than 0·5 per cent. of the unrestricted illumination from the complete sky hemisphere; (3) windows should be to the left of the pupils. Other recommendations refer to details such as the colour of walls, furniture, etc. A point deserving special attention is that most light is needed in the infant classrooms, which at present are usually less efficient as regards lighting than any other schoolrooms. The Committee consider that the Building Regulations (1907) of the Board of Education have produced good results, but find, nevertheless, many points which require further investigation. In view of the extensive character of the research, it is hoped that local authorities will be willing to assist. The Committee is of a thoroughly representative character, and has obviously proceeded with judicious care so far; we are glad to see that the Society intends to issue a reprint of this report, together with notes on Continental research and the corresponding interim report on the Artificial Lighting of Schools, issued last year.

THE handbooks for next session of the faculties of engineering and of the medical sciences at University College (University of London), Gower Street, W.C., have now been issued. The faculty of engineering, of which Prof. J. A. Fleming is dean, includes the departments of civil and mechanical engineering, electrical engineering, and municipal engineering, and is intended to provide for students wishing to devote themselves to engineering a systematic training in the application of scientific principles to industrial purposes. The courses are also suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, engineering department of the General Post Office, department of the Director of Engineering and Architectural Works in the Admiralty, Patent Office, and other similar services. The departments have been recognised by the Board of Trade as providing suitable technical training for marine engineers. Facilities are provided for post-graduate and research work in all the subjects. The faculty of medical sciences, of which Prof. A. R. Cushny is dean, comprises the departments of physics, chemistry, botany, and zoology—the preliminary medical sciences; also the departments of anatomy, physiology, and pharmacology—the intermediate medical science; and the departments of hygiene and public health, and of pathological chemistry for post-graduate study. All communications concerning these courses should be addressed to the Provost, University College, London.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 6.—Prof. James Geikie, president, in the chair.—Dr. George **Philip**: Obituary notice of John Sturgeon Mackay.—Dr. E. M. **Wedderburn** and A. W. **Young**: Temperature observations in Loch Earn. Part ii. The observations discussed were made in August, 1913, and supplied a good example of a temperature seiche. The decay of the oscillations was very rapid. Periodogram analysis indicated periods of twenty hours and ten hours. Calculation of the probable period from the mathematical theory gave a period of 19·6 hours for the principal oscillation. The records were also subjected to harmonic analysis, and the effect of light winds in altering the character of the oscillation was clearly demonstrated.—D. **Ferguson**, G. W. **Tyrrell**, and Prof. J. W. **Gregory**: Contributions to the geology of Louth. The valuable collections made by Mr. Ferguson were studied and described by Mr. Tyrrell, who gave a general petrographical report. In a further report Prof. Gregory considered the general geological problems suggested.

PARIS.

Academy of Sciences, July 27.—M. P. Appell in the chair.—Mlle. Th. **Tarnarider**: The best approximation of $x^k|x|$ by polynomials of indefinitely increasing degrees.—René **Garnier**: The representation of the integrals of Painlevé's equations by means of the theory of linear equations.—César **Spineanu**: The development of a holomorph function in series of inverses of polynomials and in series of rational fractions.—Georges **Rignoux**: An arrangement for vision at a distance. A description of a system of relays in connection with a number of selenium cells.—Maurice **de Broglie**: The spectral analysis by the secondary rays of the Röntgen rays and its application to the case of rare substances. As the method of examination, described in an earlier communication, can be applied to very small quantities of substance, the oxides of gallium and germanium have been examined. Figures are also given for antimony, tin, and lanthanum.—Henri **Labrouste**: Monomolecular layers and surfusion. A study of the solidifying points on trilaurin, tribenzoin, and trimyristin in very thin layers.—J. **Guyot**: The Volta effect and monomolecular layers. Measurements of the differences of potential appearing at the contact of gold and water when extremely thin layers of various organic substances are floating on the surface of the water.—R. **Boulouch**: The general condition of stigmatism in a system of diopters of revolution round a given axis.—MM. **Massol** and **Faucon**: The absorption of ultra-violet radiations by the chlorine derivatives of methane. Pure carbon tetrachloride gives no absorption band, and the band ascribed to this substance by several observers has been traced to the presence of carbon disulphide. Chloroform and dichloromethane also give no absorption bands.—J. **Larguier des Bancels**: The photochemical properties of the coloured resinates.—Ch. **de Rohden**: The constant presence of rare earths in scheelite as shown by cathodic phosphorescence. In scheelites of different origin a study of the phosphorescence spectrum has shown the presence of samarium, dysprosium, erbium, terbium, europium, neodymium, and praseodymium. All the elements to which the method is applicable have been found, but the relative proportions of the rare elements differ considerably from one scheelite to another. All the spectra found can be explained with the known rare elements.—Marcel **Duboux**: The estimation of potash and magnesia by a physico-chemical volumetric method. Application to the analysis of wine. The method is based on the changes of electrical conductivity produced by the gradual addition of an appropriate reagent.—J. **Blumenfeld** and G. **Urbain**: The isolation of neoytterbium. As a criterion of purity of a fraction, the magnetisation coefficient possesses advantages over the usual spectrum methods. This has been applied to the products resulting from a long series of fractionations of the earths of the ytterbium group, and the name neoytterbium has been given to one of the earths isolated in this way. It is defined by its magnetisation coefficient, spectrum, and atomic weight (173·54).—André **Brochet** and André **Cabaret**: The addition of hydrogen in the presence of nickel at atmospheric pressure to compounds with fatty ethylene linkings. Details of experiments on the hydrogenation of 1-octene, cinnamic acid and its derivatives, allyl, alcohol, anethol, isosafrol, and some unsaturated ketones.—MM. **Cousin** and **Volmar**: Some nitro- and amino-derivatives of orthocyanophenol.—F. **Jadin** and A. **Astruc**: Manganese in some springs of the central *massif*.—Julien **Loisel**: The construction of a monogram representative of the mean direction of the wind.—M. **Gazaud**: Contribution to the study of the mistral.—M. **Chifflot**: The extension of *Marsonia rosae* in cultures of roses. Precautions necessary to prevent the attack of rose trees by this parasite.—Em. **Miège** and H. **Coupé**: The influence of the X-rays on vegetation.—Mme. Victor **Henri**: Study of the metabiotic action of the ultra-violet rays. Modification of the morphological and biochemical characters of anthrax bacilli. Transmission of the acquired characters.—Mme. Z. **Gruzewska**: The action of some diastases on the dextrins.—T. **Salimbeni**: Bacteriological researches on scarlatina. A description of a new micro-organism found in the blood of fifteen out of twenty cases of the disease.

BOOKS RECEIVED.

Report of the Fourteenth Meeting of the Australasian Association for the Advancement of Science. Held at Melbourne, 1913. By Dr. T. S. Hall. Pp. xcii+751. (Sydney: Australasian Association.)

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Zoology. Vol. i. No. 1. Fishes. By C. T. Regan. Pp. 54+xiii plates. (London: British Museum (Natural History), and Longmans, Green and Co.) 10*s*. 6*d*.

Indian Forest Insects of Economic Importance. Coleoptera. By E. P. Stebbing. Pp. xvi+648. (London: Eyre and Spottiswoode.) 15*s*.

English Literature for Schools. The Early Life of Thomas De Quincey from his Own Writings. Edited by A. Burrell. Pp. 124. (London: J. M. Dent and Sons, Ltd.) 6*d*.

Agriculture in the Tropics. An Elementary Treatise. By Dr. J. C. Willis. Second edition, revised. Pp. xvi+223. (Cambridge University Press.) 9*s*. net.

A Manual of Mechanical Drawing. By J. H. Dales. Pp. xii+181. (Cambridge University Press.) 3*s*. net.

The Story of Plant Life in the British Isles. Types of the Natural Orders. By A. R. Horwood. Vol. ii. Pp. xiv+358. (London: J. and A. Churchill.) 6*s*. 6*d*. net.

Carnegie Endowment for International Peace. Division of Intercourse and Education. Publication No. 4: Report of the International Commission to inquire into the Causes and Conduct of the Balkan Wars. Pp. ix+415. (Washington: Carnegie Endowment.)

Department of the Interior. U.S. Geological Survey. Professional Paper 86: The Transportation of Débris by Running water, by G. K. Gilbert. Pp. 263. (Washington: Government Printing Office.)

A First School Botany. By E. M. Goddard. Pp. xiii+191. (London: Mills and Boon, Ltd.) 2*s*. 6*d*.

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THURSDAY, AUGUST 20, 1914.

FISHERIES AND FISH-CULTURE.

Traité Raisonné de la Pisciculture et des Pêches. By Prof. Louis Roule. Pp. viii + 734. (Paris: J. B. Baillière et Fils, 1914.)

FRANCE has held aloof from the international fishery investigations in which most of the other countries of northern Europe have been engaged during the last decade, and such fishery work as has been carried out by Frenchmen has progressed upon somewhat independent lines. It is therefore interesting to receive a general work by a Frenchman dealing with fishes and fishery questions in a comprehensive, but at the same time somewhat popular way, and to see familiar questions looked at from a different aspect and treated in a more lively and entertaining manner than that to which we have recently been accustomed. Although Prof. Roule's work is a volume of more than seven hundred pages, it must, however, be regarded neither as a text-book suited to the requirements of the student of fishery science, nor as a practical handbook for those whose business it is to concern themselves with fishery administration or with fish culture for commercial purposes. The general results of much recent scientific research are, it is true, explained in a clear and illuminating way, but little or nothing is said as to the methods, often very laborious and involving a close and minute study of a vast number of detailed observations, by which those results have been obtained. Often, too, we are afraid the author does not sufficiently discriminate between results which may be regarded as established scientific facts and mere working hypotheses which are useful enough or indeed essential as guides to future work, but would not be considered, even by those who have fathered them, as settled conclusions. Throughout the book there are no detailed references to the literature of the subject, although there are a number of references in footnotes to the names of authors well known for their fishery work.

The book, nevertheless, does fill a very useful place of its own. It will appeal strongly to that numerous class of fishermen and naturalists, both amateur and professional, to whom the habits and natural history of fishes, their migrations, their modes of feeding and of generation, and the general history of their lives are questions of never failing interest and speculation. To all such it may be confidently recommended. The author deals with both sea- and fresh-water fishes, and his book is divided into three parts. The first part treats in 180 pages of fishes in general and of the conditions under which they live. The general features of aquatic life are described, and the nature of the fixed and floating animals and plants found in the sea- and in fresh-water is considered. The structure of fishes and the physiology of their nutrition, their sensations and their reproduction are also treated of in a way that can be easily understood and in a logical sequence which makes the account both suggestive and interesting. Part ii., to which 262 pages are devoted, deals with sea fishes and sea fisheries. Some account is first given of the physical and chemical conditions of sea water, including a discussion of tides, waves, and currents. The general physical characters of the sea floor are also touched upon. This is followed by a more detailed discussion of the various methods of fishing which are practised both in coastal waters and on the high seas. The author has succeeded in imparting very great interest into this part of his work and, especially when dealing with the tunny fisheries, he has introduced an amount of vigour and excitement into his descriptions which we do not frequently meet with in works of this kind. Considerable space is devoted to the pelagic migratory fishes, such as the mackerel, herring, pilchard, and anchovy, and the many different theories as to the extent of their movements which have been put forward from time to time are discussed. The author agrees with those modern writers who have concluded that the actual distances travelled by the shoals of these fishes are by no means so great as was at one time supposed.

Comparatively few pages are given to the question of the hatching and rearing of sea fishes and Prof. Roule is clearly of opinion that no great results are likely to be attained by this method of attempting to increase the harvest of the open sea. His views are summarised in this passage (p. 429):—"Mais on connaît la faiblesse de la pisciculture marine; l'immersion dans la mer de plusieurs millions d'alevins n'augmenterait la population habituelle que d'une proportion infinitésimale. Les facilités naturelles de la reproduction suffisent d'elles-mêmes. Aussi, la méthode économique ne consiste point tant à s'ingénier vers la piscifacture, comme à favoriser le peuplement naturel par la surveillance et la sauvegarde des jeunes sur leurs alevinières."

The third part of the work treats of fresh-water fishes and to this subject 255 pages are given. This is, perhaps, on the whole, the most satisfactory part of the book. The author seems to be more at home with his subject and to be writing more within the limits of his own special experience. There can be no question also that practical results are much more easy of attainment when dealing with fresh-water fishes than when dealing with those of the sea. The methods of artificial hatching and rearing have been thoroughly worked out and put into practice, and they are here well described.

The book is profusely illustrated and the illustrations are of such a character that both the interest and the clearness of the descriptions are enhanced.

ECONOMIC ANALYSIS.

(1) *Investigating an Industry: a Scientific Diagnosis of the Diseases of Management.* By W. Kent. With an Introduction by H. L. Gantt. Pp. xi+126. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 4*s*. 6*d*. net.

(2) *Principles of Economics.* By Prof. H. R. Seager. Pp. xx+650. (London: G. Bell and Sons, Ltd.; New York: H. Holt and Co., 1913.) Price 10*s*. 6*d*. net.

(1) MR. KENT'S book belongs to a branch of investigation which has been specially developed in America. It might seem at first that business management scarcely belonged to science, but was rather a question of personal qualification, tact, and resource. When we speak of good management in this country we are inclined to regard it mainly as concerned with labour-saving methods. But this book, and others on the same lines, aim at applying to the faults of business the scientific methods of medical diagnosis; and Mr. Kent has given great vividness to his analysis by working it out in the concrete case of an individual business faced with competition and a falling market. To meet the case, each aspect of organisation, within and without the factory, is examined in detail by an expert. Is the location of the works where it should be, in view of the buying and selling markets, and conditions of transport? Are the buildings well equipped, and are they too large or too small for the most economical output? Is the power plant modern, or does it waste fuel? Are the high-priced men on work which really requires their skill, or are they being wasted on low-price work? What is the "load-factor" of the machinery—its percentage of running full—both in general and for each machine? How are accounts kept and audited? Are the directors and manager "running full" themselves? An inquisition into each aspect shows, in the case taken, that the main technical fault is the want of a supplementary product to balance fluctuations in the main output, and occupy the spare factory space; while the main defect of organisation is in the work of the directors themselves. The book is full of the keen business spirit of America. Students of scientific economics will be interested to see how, in various detailed ways, the broad principles of the "marginal" method are illustrated.

(2) Prof. Seager has revised and expanded his "Introduction to Economics," and the "Principles" are now a very full treatment of both theory and description. There are also some important historical chapters, so that the book is much wider than its title suggests. In the theoretical chapters, the marginal principle is developed and illustrated with a welcome abundance of comment and illustration. The most interesting, to English readers, of the new chapters are those on social insurance and on profit-sharing; but Prof. Seager is content rather with description here, and some important general questions might have been raised from the point of view of analysis and social ethics. To American readers the chapter on the income tax is appropriate and up to date. It is one of the most valuable of those text-books which are now confirming and establishing the structure of the science.

D. H. M.

OUR BOOKSHELF.

Geological Map of the Caucasus, with Explanatory Notes. By Dr. F. Oswald. (London: Dulau and Co., Ltd., 1914.) Price 15*s*. net.

DR. OSWALD's colour-printed map of the Caucasus is on the scale of 1 : 1,000,000, and covers the country from the Sea of Azov to the Caspian. We may regret that the heights are given in English feet; but those who use it will generally have other topographic maps at hand. It is produced in a bold style, somewhat like that of Noë's map of the Alps, and embodies a good deal of personal study by the author. The descriptive pamphlet directs attention to the production of crystalline schists and the intrusion of granite in pre-Carboniferous times. Intense folding took place in the Upper Jurassic epoch, the pressure acting from the south-west; and the latest and still more important folding, this time induced from the north-east, is of Miocene and even post-Sarmatian age. Kazbek and Elburs are enormous volcanic piles, due to the outwelling of lavas along fractures connected with the final earth-movements of Pliocene times. The author's classification of the Miocene strata brings the Sarmatian into the middle of the system, so that almost all the beds regarded as Miocene in western Europe are crowded into one Lower or Vindobonian series. He retains an Oligocene system, mostly marine, which is well marked off from the prevalent flysch type of Eocene strata.

This work will be of service to many travellers, now that the district is so accessible through Constantinople or Odessa, and it will be of much help to readers of Suess's description of the range.

G. A. J. C.

Catalogue of Scientific Papers. Fourth series (1884–1900). Compiled by the Royal Society. Vol. xiii., A—B. Pp. xcviii+951. (Cambridge University Press, 1914.) Price 2*l.* 10*s.* net.

The fourth series of the Royal Society's Catalogue of Scientific Papers, of which the present is the first volume, comprises the titles of papers published or read during the period 1884–1900, and concludes the work undertaken by the Royal Society. The catalogue thus completed will contain titles of papers for the whole of the nineteenth century. The continuation of the work is now in the hands of the authorities of the International Catalogue of Scientific Literature, which deals with the titles and subjects of papers published after the end of 1900.

This volume contains 11,551 entries of titles of papers by 2001 authors with the initial A, and 51,720 entries of papers by 6928 authors with the initial B, making a total of 63,271 entries by 8929 authors.

A list of the 1555 serials which have been examined for the preparation of this section of the catalogue, with the abbreviations used for their titles, is given at the beginning of the volume.

The complete risk of printing and publishing the Catalogue of Scientific Papers and the Subject Index has been undertaken by the Cambridge University Press, and we echo the hope of the Catalogue Committee that the circulation of the volumes throughout the scientific world will be large enough to prevent financial loss.

LETTERS TO THE EDITOR.

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

The Peregrine Falcon at the Eyrie.

In the notice of Mr. Heatherley's "The Peregrine Falcon at the Eyrie" (Nature, August 6, p. 586), that author is quoted for the previously "unrecorded fact that after the first few days the falcon turned over to the tiercel the duties of her sex, spending his time abroad hunting and bringing the quarry to the tiercel, who remained at home to feed and look after the young." This sentence in its wording appears to treat the falcon as male, the tiercel as female; the reverse being, however, the correct use of these terms. As Harting ("Birds of Shakespeare," p. 52) says: "By the falcon is always understood the female, as distinguished from the tercel, or male, of the peregrine or goshawk."

W. E. Hart.

Kilderry, Londonderry, August 7.

Mr. Hart is quite correct. The term "tiercel" has always been applied to the male peregrine falcon, *cf.* Newton's "Dictionary of Birds" *et passim.* The notice in which the quoted sentence occurs was contributed from the reviewer's sick bed, and he is only now aware that a point of interrogation after "his" and before "time," which was in his original draft, had dropped from his MS. and its omission had escaped him in the proof.

The Reviewer.

PRACTICAL EDUCATION.[1]

The title of Mr. Legge's book is suggestive of a painting in the University of Bologna, in which Science is represented by a female figure with eyes in each of her extended hands. We are so apt to speak of "seeing" when we mean "perceiving" that we forget that the blind can see with their hands, and that science throughout the centuries has achieved most of her triumphs by the knowledge acquired by means of hand-work. It was early explained that the chief educational advantage of manual training was to exercise the hand from childhood as an instrument for acquiring knowledge, and so to create an additional perceptive sense.

Since the years 1887–1890, when hand-work was first introduced as a scientific experiment into elementary schools, and was then proved to be the means of stimulating the intellectual activity of children, making them more alert in all other studies, the advances in this new educational departure, if not rapid, have been unbroken, and have been carried forward in many different directions. The recognition of the value of manual work in the education of children is now very general. Nevertheless, Mr. Legge has devoted some of the few pages of his letterpress in answering those opponents who, in the early history of the movement, charged its advocates with infringing the principles of elementary education, with trenching on technical instruction and prematurely encouraging vocational teaching.

Mr. Legge has successfully refuted all these arguments. In the chapter of his book headed, "The Growth of an Idea," he has not attempted to give anything approaching to a history of the movement, or he would have referred to those early efforts which in 1890 induced the then Education Department to include in the Code of that year regulations for the teaching of hand-work under conditions carrying a Government grant. Indeed, the few short chapters of his book, although well worth reading, are not intended to add anything to what may be found in other treatises. In his own words, "The letterpress is here simply to explain and lead up to the illustrations," which, he states, are designed to give the general public a view of the practical side of the instruction now provided in schools.

These illustrations, more than four hundred in number, admirably fulfil that purpose. They show how varied may be the exercises which are now practised in the conduct of the modern side of elementary schools, and experience has fully borne out his contention that these exercises are all, or nearly all, equally efficient in stimulating the intelligence of children. Indeed, the value of manual training is shown to depend far more on the method of instruction than on the materials employed, or on the models that are made. The illustrations, of which this book largely consists, show children occupied with educational exercises in such diverse materials as wood and metal,

[1] "The Thinking Hand; or, Practical Education in the Elementary School." By J. G. Legge. Pp. x+217. (London: Macmillan and Co., Ltd., 1914.) Price 8*s* 6*d.* net.

cardboard, rope and cane, leather and stone, and they also show children engaged in housewifery in

FIG. 1.—School Gardening. Morrison Council School. From "The Thinking Hand."

all its branches, in the construction of simple scientific apparatus, in gardening, and in other forms of hand-work. Of these illustrations we select two, one showing gardening practice at the Morrison County School, and the other the apparatus and models made at St. Michael's County School.

Not the least instructive section of Mr. Legge's book is that in which are found suggestions for courses of instruction in hygiene, household science, and the care of infants, with syllabuses of cookery and laundry work. These cannot fail to serve as useful guides to many teachers.

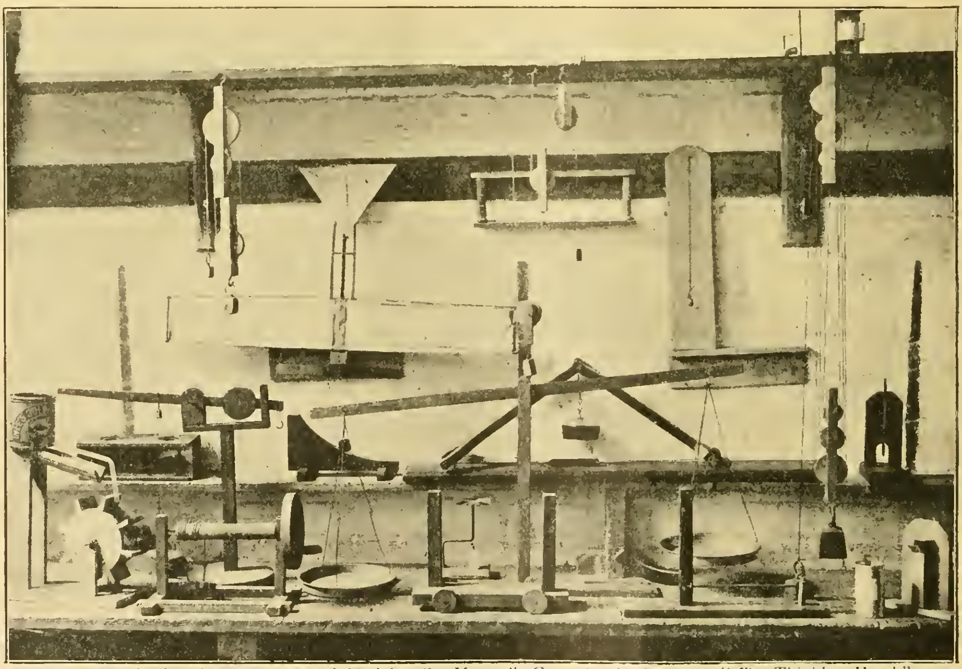


FIG. 2.—School-made Apparatus and Models St. Michael's Council School. From "The Thinking Hand."

The letterpress, short as it is, covering only 36 out of the 217 pages of which the book consists, contains many tersely expressed conclusions on the value of hand-work and on various matters connected with school administration, which the author's experience as Director of Education of the City of Liverpool has enabled him to form. Very truly he says, "It is a serious question whether the whole system of modern education up to the most recent days has not devoted itself too assiduously to a one-sided intellectual culture." This is so, and the Board of Education, although recognising fully the value of hand-work as a means of educational discipline, has not yet realised the urgent need of giving to manual training in one or other of its many forms its proper place in the school curriculum.

The author does well to plead for considerable liberty in the teaching of these subjects. Freedom on the part of the teacher to use his own initiative and judgment in determining the exercises to be given to his pupils is essential, for unless he himself is interested in the work in which his pupils are engaged, his instruction will prove of little value. The author is on equally safe ground when he says, "It is not only teachers that call out for liberty; local education authorities are beginning actively to resent the evil of a central bureaucracy drawn tighter and tighter."

Although the number of text-books and essays on manual training already published is very large, we believe Mr. Legge's book will be found to be a valuable addition to the works which teachers and administrators may usefully consult.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

Inaugural Address by Prof. William Bateson, M.A., F.R.S., President.

Part I.—Melbourne.

The outstanding feature of this meeting must be the fact that we are here—in Australia. It is the function of a president to tell the association of advances in science, to speak of the universal rather than of the particular or the temporary. There will be other opportunities of expressing the thoughts which this event must excite in the dullest heart, but it is right that my first words should take account of those achievements of organisation and those acts of national generosity by which it has come to pass that we are assembled in this country. Let us, too, on this occasion, remember that all the effort, and all the goodwill, that binds Australia to Britain would have been powerless to bring about such a result had it not been for those advances in science which have given man a control of the forces of nature. For we are here by virtue of the feats of genius of individual men of science, giant-variations from the common level of our species; and since I am going soon to speak of the significance of individual variation, I cannot introduce that subject better than by calling to remembrance the line of pioneers in chemistry, in physics, and in engineering, by the working of whose rare—or, if you will, abnormal—intellects a meeting of the British Association on this side of the globe has been made physically possible.

I have next to refer to the loss within the year of Sir David Gill, a former president of this association, himself one of the outstanding great. His greatness lay in the power of making big foundations. He built up the Cape Observatory; he organised international geodesy; he conceived and carried through the plans for the photography of the whole sky, a work in which Australia is bearing a conspicuous part. Astronomical observation is now organised on an international scale, and of this great scheme Gill was the heart and soul. His labours have ensured a base from which others will proceed to discovery otherwise impossible. His name will be long remembered with veneration and gratitude.

As the subject of the addresses which I am to deliver here and in Sydney I take *Heredity*. I shall attempt to give the essence of the discoveries made by Mendelian or analytical methods of study, and I shall ask you to contemplate the deductions which these physiological facts suggest in application both to evolutionary theory at large and to the special case of the natural history of human society.

Recognition of the significance of heredity is modern. The term itself in its scientific sense is no older than Herbert Spencer. Animals and plants are formed as pieces of living material split from the body of the parent organisms. Their powers and faculties are fixed in their physiological origin. They are the consequence of a genetic process, and yet it is only lately that this genetic process has become the subject of systematic research and experiment. The curiosity of naturalists has of course always been attracted to such problems; but that accurate knowledge of genetics is of paramount importance in any attempt to understand the nature of living things has only been realised quite lately even by naturalists, and with casual exceptions the laity still know nothing of the matter. Historians debate the past of the human species, and statesmen order its present or profess to guide its future as if the animal man, the unit of their calculations, with his vast diversity of powers, were a homogeneous material, which can be multiplied like shot.

The reason for this neglect lies in ignorance and misunderstanding of the nature of variation; for not until the fact of congenital diversity is grasped, with all that it imports, does knowledge of the system of hereditary transmission stand out as a primary necessity in the construction of any theory of evolution, or any scheme of human polity.

The first full perception of the significance of variation we owe to Darwin. The present generation of evolutionists realises perhaps more fully than did the scientific world in the last century that the theory of evolution had occupied the thoughts of many and found acceptance with not a few before ever the "Origin" appeared. We have come also to the conviction that the principle of natural selection cannot have been the chief factor in delimiting the species of animals and plants, such as we now with fuller knowledge see them actually to be. We are even more sceptical as to the validity of that appeal to changes in the conditions of life as direct causes of modification, upon which latterly at all events Darwin laid much emphasis. But that he was the first to provide a body of fact demonstrating the variability of living things, whatever be its causation, can never be questioned.

There are some older collections of evidence, chiefly the work of the French school, especially of Godron [1]—and I would mention also the almost forgotten essay of Wollaston [2]—these, however, are only fragments in comparison. Darwin regarded variability as a property inherent in living things, and eventually we must consider whether this conception is well founded; but postponing that inquiry for the present, we may declare that with him began a general recognition of variation as a phenomenon widely occurring in nature.

If a population consists of members which are not alike but differentiated, how will their characteristics be distributed among their offspring? This is the problem which the modern student of heredity sets out to investigate. Formerly it was hoped that by the simple inspection of embryological processes the modes of heredity might be ascertained, the actual mechanism by which the offspring is formed from the body of the parent. In that endeavour a noble pile of evidence has been accumulated. All that can be made visible by existing methods has been seen, but we come little

1 "De l'Espèce et des Races dans les Êtres Organisés," 1859.
2 "On the Variation of Species," 1856.

if at all nearer to the central mystery. We see nothing that we can analyse further—nothing that can be translated into terms less inscrutable than the physiological events themselves. Not only does embryology give no direct aid, but the failure of cytology is, so far as I can judge, equally complete. The chromosomes of nearly related creatures may be utterly different both in number, size, and form. Only one piece of evidence encourages the old hope that a connection might be traceable between the visible characteristics of the body and those of the chromosomes. I refer, of course, to the accessory chromosome, which in many animals distinguishes the spermatozoon about to form a female in fertilisation. Even it, however, cannot be claimed as the cause of sexual differentiation, for it may be paired in forms closely allied to those in which it is unpaired or accessory. The distinction may be present or wanting, like any other secondary sexual character. Indeed, so long as no one can show consistent distinctions between the cytological characters of somatic tissues in the same individual we can scarcely expect to perceive such distinctions between the chromosomes of the various types.

For these methods of attack we now substitute another, less ambitious, perhaps, because less comprehensive, but not less direct. If we cannot see how a fowl by its egg and its sperm gives rise to a chicken or how a sweet pea from its ovule and its pollen grain produces another sweet pea, we at least can watch the system by which the differences between the various kinds of fowls or between the various kinds of sweet peas are distributed among the offspring. By thus breaking the main problem up into its parts we give ourselves fresh chances. This analytical study we call Mendelian because Mendel was the first to apply it. To be sure, he did not approach the problem by any such line of reasoning as I have sketched. His object was to determine the genetic definiteness of species; but though in his writings he makes no mention of inheritance, it is clear that he had the extension in view. By cross-breeding he combined the characters of varieties in mongrel individuals and set himself to see how these characters would be distributed among the individuals of subsequent generations. Until he began this analysis nothing but the vaguest answers to such a question had been attempted. The existence of any orderly system of descent was never even suspected. In their manifold complexity human characteristics seemed to follow no obvious system, and the fact was taken as a fair sample of the working of heredity.

Misconception was especially brought in by describing descent in terms of "blood." The common speech uses expressions such as consanguinity, pure-blooded, half-blood, and the like, which call up a misleading picture to the mind. Blood is in some respects a fluid, and thus it is supposed that this fluid can be both quantitatively and qualitatively diluted with other bloods, just as treacle can be diluted with water. Blood in primitive physiology being the peculiar vehicle of life, at once its essence and its corporeal abode, these ideas of dilution and compounding of characters in the commingling of bloods inevitably suggest that the ingredients of the mixture once combined are inseparable, that they can be brought together in any relative amounts, and in short that in heredity we are concerned mainly with a quantitative problem. Truer notions of genetic physiology are given by the Hebrew expression "seed." If we speak of a man as "of the blood-royal" we think at once of plebeian dilution, and we wonder how much of the royal fluid is likely to be "in his veins"; but if we say he is "of the seed of Abraham" we feel something of the permanence and indestructibility of that germ which can be divided and scattered among all nations, but remains recognisable in type and characteristics after 4000 years.

I knew a breeder who had a chest containing bottles of coloured liquids by which he used to illustrate the relationships of his dogs, pouring from one to another and titrating them quantitatively to illustrate their pedigrees. Galton was beset by the same kind of mistake when he promulgated his "Law of Ancestral Heredity." With modern research all this has been cleared away. The allotment of characteristics among offspring is not accomplished by the exudation of drops of a tincture representing the sum of the characteristics of the parent organism, but by a process of *cell-division*, in which numbers of these characters, or rather the elements upon which they depend, are sorted out among the resulting germ-cells in an orderly fashion. What these elements, or *factors* as we call them, are we do not know. That they are in some way directly transmitted by the material of the ovum and of the spermatozoon is obvious, but it seems to me unlikely that they are in any simple or literal sense material particles. I suspect rather that their properties depend on some phenomenon of arrangement. However that may be, analytical breeding proves that it is according to the distribution of these genetic factors, to use a non-committal term, that the characters of the offspring are decided. The first business of experimental genetics is to determine their number and interactions, and then to make an analysis of the various types of life.

Now the ordinary genealogical trees, such as those which the studbooks provide in the case of the domestic animals, or the Heralds' College provides in the case of man, tell nothing of all this. Such methods of depicting descent cannot even show the one thing they are devised to show—purity of "blood." For at last we know the physiological meaning of that expression. An organism is pure-bred when it has been formed by the union in fertilisation of two germ-cells which are alike in the factors they bear; and since the factors for the several characteristics are independent of each other, this question of purity must be separately considered for each of them. A man, for example, may be pure-bred in respect of his musical ability and cross-bred in respect of the colour of his eyes or the shape of his mouth. Though we know nothing of the essential nature of these factors, we know a good deal of their powers. They may confer height, colour, shape, instincts, powers both of mind and body; indeed, so many of the attributes which animals and plants possess that we feel justified in the expectation that with continued analysis they will be proved to be responsible for most if not all of the differences by which the varying individuals of any species are distinguished from each other. I will not assert that the greater differences which characterise distinct species are due generally to such independent factors, but that is the conclusion to which the available evidence points. All this is now so well understood, and has been so often demonstrated and expounded, that details of evidence are now superfluous.

But for the benefit of those who are unfamiliar with such work let me briefly epitomise its main features and consequences. Since genetic factors are definite things, either present in or absent from any germ-cell, the individual may be either "pure-bred" for any particular factor, or its absence, if he is constituted by the union of two germ-cells both possessing or both destitute of that factor. If the individual is thus pure, all his germ-cells will in that respect be identical, for they are simply bits of the similar germ-cells which united in fertilisation to produce the parent organism. We thus reach the essential principle, that an organism cannot pass on to offspring a factor which it did not itself receive in fertilisation. Parents, therefore, which are both destitute of a given factor can only produce offspring equally destitute of it; and, on the contrary, parents both pure-bred for the presence of a factor produce offspring equally pure-bred for its presence. Whereas the germ-cells of the pure-bred are all alike, those of the cross-bred, which results from the union of dissimilar germ-cells, are mixed in character. Each positive factor segregates from its negative opposite, so that some germ-cells carry the factor and some do not. Once the factors have been identified by their effects, the average composition of the several kinds of families formed from the various matings can be predicted.

Only those who have themselves witnessed the fixed operations of these simple rules can feel their full significance. We come to look behind the simulacrum of the individual body, and we endeavour to disintegrate its features into the genetic elements by whose union the body was formed. Set out in cold general phrases, such discoveries may seem remote from ordinary life. Become familiar with them, and you will find your outlook on the world has changed. Watch the effects of segregation among the living things with which you have to do—plants, fowls, dogs, horses, that mixed concourse of humanity we call the English race, your friends' children, your own children, yourself—and however firmly imagination be restrained to the bounds of the known and the proved, you will feel something of that range of insight into nature which Mendelism has begun to give. The question is often asked whether there are not also in operation systems of descent quite other than those contemplated by the Mendelian rules. I myself have expected such discoveries, but hitherto none have been plainly demonstrated. It is true we are often puzzled by the failure of a parental type to reappear in its completeness after a cross—the merino sheep or the fantail pigeon, for example. These exceptions may still be plausibly ascribed to the interference of a multitude of factors, a suggestion not easy to disprove; though it seems to me equally likely that segregation has been in reality imperfect. Of the descent of quantitative characters we still know practically nothing. These and hosts of difficult cases remain almost untouched. In particular the discovery of E. Baur, and the evidence of Winkler in regard to his "graft hybrids," both showing that the sub-epidermal layer of a plant—the layer from which the germ-cells are derived—may bear exclusively the characters of a part only of the soma, give hints of curious complications, and suggest that in plants at least the interrelations between soma and gamete may be far less simple than we have supposed. Nevertheless, speaking generally, we see nothing to indicate that qualitative characters descend, whether in plants or animals, according to systems which are incapable of factorial representation.

The body of evidence accumulated by this method of analysis is now very large, and is still growing fast by the labours of many workers. Progress is also beginning along many novel and curious lines. The details are too technical for inclusion here. Suffice it to say that not only have we proof that segregation affects a vast range of characteristics, but in the course of our analysis phenomena of most unexpected kinds have been encountered. Some of these things twenty years ago must have seemed inconceivable. For example, the two sets of sex organs, male and female, of the same plant may not be carrying the same characteristics; in some animals characteristics, quite independent of sex, may be distributed solely or predominantly to one sex; in certain species the male may be breeding true to its own type, while the female is permanently mongrel, throwing off eggs of a distinct variety in addition to those of its own type; characteristics, essentially independent, may be associated in special combinations which are largely retained in the next generation, so that among the grandchildren there is numerical preponderance of those combinations which existed in the grandparents—a discovery which introduces us to a new phenomenon of polarity in the organism.

We are accustomed to the fact that the fertilised egg has a polarity, a front and hind end, for example; but we have now to recognise that it, or the primitive germinal cells formed from it, may have another polarity shown in the groupings of the parental elements. I am entirely sceptical as to the occurrence of segregation solely in the maturation of the germ-cells,[3] preferring at present to regard it as a special case of that patch-work condition we see in so many plants. These mosaics may break up, emitting bud-sports at various cell-divisions, and I suspect that the great regularity seen in the F_2 ratios of the cereals, for example, is a consequence of very late segregation, whereas the excessive irregularity found in other cases may be taken to indicate that segregation can happen at earlier stages of differentiation.

The paradoxical descent of colour-blindness and other sex-limited conditions—formerly regarded as an inscrutable caprice of nature—has been represented with approximate correctness, and we already know something as to the way, or, perhaps, I should say ways, in which the determination of sex is accomplished in some of the forms of life—though, I hasten to add, we have no inkling as to any method by which that determination may be influenced or directed. It is obvious that such discoveries have bearings on most of the problems, whether theoretical or practical, in which animals and plants are concerned. Permanence or change of type, perfection of type, purity or mixture of race, "racial development," the succession of forms, from being vague phrases expressing matters of degree, are now seen to be capable of acquiring physiological meanings, already to some extent assigned with precision. For the naturalist—and it is to him that I am especially addressing myself to-day—these things are chiefly significant as relating to the history of organic beings—the theory of evolution, to use our modern name. They have, as I shall endeavour to show in my second address to be given in Sydney, an immediate reference to the conduct of human society.

I suppose that everyone is familiar in outline with the theory of the origin of species which Darwin promulgated. Through the last fifty years this theme of the Natural Selection of favoured races has been developed and expounded in writings innumerable. Favoured races certainly can replace others. The argument is sound, but we are doubtful of its value. For us that debate stands adjourned. We go to Darwin for his incomparable collection of facts. We would fain emulate his scholarship, his width and his power of exposition, but to us he speaks no more with philosophical authority. We read his scheme of evolution as we would those of Lucretius or of Lamarck, delighting in their simplicity and their courage. The practical and experimental study of variation and heredity has not merely opened a new field; it has given a new point of view and new standards of criticism. Naturalists may still be found

[3] The fact that in certain plants the male and female organs respectively carry distinct factors may be quoted as almost decisively negativing the suggestion that segregation is confined to the reduction division.

expounding teleological systems[4] which would have delighted Dr. Pangloss himself, but at the present time few are misled. The student of genetics knows that the time for the development of theory is not yet. He would rather stick to the seed-pan and the incubator.

In face of what we now know of the distribution of variability in nature, the scope claimed for natural selection in determining the fixity of species must be greatly reduced. The doctrine of the survival of the fittest is undeniable so long as it is applied to the organism as a whole, but to attempt by this principle to find value in all definiteness of parts and functions, and in the name of science to see fitness everywhere, is mere eighteenth-century optimism. Yet it was in application to the parts, to the details of specific difference, to the spots on the peacock's tail, to the colouring of an orchid flower, and hosts of such examples, that the potency of natural selection was urged with the strongest emphasis. Shorn of these pretensions the doctrine of the survival of favoured races is a truism, helping scarcely at all to account for the diversity of species. Tolerance plays almost as considerable a part. By these admissions almost the last shred of that teleological fustian with which Victorian philosophy loved to clothe the theory of evolution is destroyed. Those who would proclaim that whatever is is right will be wise henceforth to base this faith frankly on the impregnable rock of superstition and to abstain from direct appeals to natural fact.

My predecessor said last year that in physics the age is one of rapid progress and profound scepticism. In at least as high a degree this is true of biology, and as a chief characteristic of modern evolutionary thought we must confess also to a deep but irksome humility in presence of great vital problems. Every theory of evolution must be such as to accord with the facts of physics and chemistry, a primary necessity to which our predecessors paid small heed. For them the unknown was a rich mine of possibilities on which they could freely draw. For us it is rather an impenetrable mountain out of which the truth can be chipped in rare and isolated fragments. Of the physics and chemistry of life we know next to nothing. Somehow the characters of living things are bound up in properties of colloids, and are largely determined by the chemical powers of enzymes, but the study of these classes of matter have only just begun. Living things are found by a simple experiment to have powers undreamt of, and who knows what may be behind?

Naturally we turn aside from generalities. It is no time to discuss the origin of the Mollusca or of Dicotyledons, while we are not even sure how it came to pass that *Primula obconica* has in twenty-five years produced its abundant new forms almost under our eyes. Knowledge of heredity has so reacted on our conceptions of variation that very competent men are even denying that variation in the old sense is a genuine occurrence at all. Variation is postulated as the basis of all evolutionary change. Do we then as a matter of fact find in the world about us variations occurring of such a kind as to warrant faith in a contemporary progressive evolution? Till lately most of us would have said "yes" without misgiving. We should have pointed, as Darwin did, to the immense range of diversity seen in many wild species, so commonly that the difficulty is to define the types themselves. Still more conclusive seemed the profusion of forms in the various domesticated animals and plants, most of them incapable of existing even for a generation in the wild state, and therefore fixed unquestionably by human selection. These, at least, for certain, are new forms, often distinct enough to pass for species, which have arisen by variation. But when analysis is applied to this mass of variation the matter wears a different aspect. Closely examined, what is the "variability" of wild species? What is the natural fact which is denoted by the statement that a given species exhibits much variation? Generally one of two things: either that the individuals collected in one locality differ among themselves; or perhaps more often that samples from separate localities differ from each other. As direct evidence of variation it is clearly to the first of these phenomena that we must have recourse—the heterogeneity of a population breeding together in one area. This heterogeneity may be in any degree, ranging from slight differences that systematists would disregard, to a complex variability such as we find in some moths, where there is an abundance of varieties so distinct that many would be classified as specific forms but for the fact that all are freely breeding together. Naturalists formerly supposed that any of these varieties might be bred from any of the others. Just as the reader of novels is prepared to find that any kind of parents might have any kind of children in the course of the story, so was the evolutionist ready to believe that any pair of moths might produce any of the varieties included in the species. Genetic analysis has disposed of all these mistakes. We have no longer the smallest doubt that in all these examples the varieties stand in a regular descending order, and that they are simply terms in a series of combinations of factors separately transmitted, of which each may be present or absent.

The appearance of contemporary variability proves to be an illusion. Variation from step to step in the series must occur either by the addition or by the loss of a factor. Now, of the origin of new forms *by loss* there seems to me to be fairly clear evidence, but of the *contemporary acquisition* of any new factor I see no satisfactory proof, though I admit there are rare examples which may be so interpreted. We are left with a picture of variation utterly different from that which we saw at first. Variation now stands out as a definite physiological event. We have done with the notion that Darwin came latterly to favour, that large differences can arise by accumulation of small differences. Such small differences are often mere ephemeral effects of conditions of life, and as such are not transmissible; but even small differences, when truly genetic, are factorial like the larger ones, and there is not the slightest reason for supposing that they are capable of summation. As to the origin or source of these positive separable factors, we are without any indication or surmise. By their effects we know them to be definite, as definite, say, as the organisms which produce diseases; but how they arise and how they come to take part in the composition of the living creature so that when present they are treated in cell-division as constituents of the germs, we cannot conjecture.

It was a commonplace of evolutionary theory that at least the domestic animals have been developed from a few wild types. Their origin was supposed to present no difficulty. The various races of fowl, for instance, all came from *Gallus bankiva*, the Indian

[4] I take the following from the abstract of a recent Croonian Lecture "On the Origin of Mammals" delivered to the Royal Society:—"In Upper Triassic times the larger Cynodonts preyed upon the large Anomodont, Kannemeyeria, and carried on their existence so long as these Anomodonts survived, but died out with them about the end of the Trias or in Rhætic times. The small Cynodonts, having neither small Anomodonts nor small Cotylosaurs to feed on, were forced to hunt the very active long-limbed Thecodonts. The greatly increased activity brought about that series of changes which formed the mammals—the flexible skin with hair, the four-chambered heart and warm blood, the loose jaw with teeth for mastication, an increased development of tactile sensation and a great increase of cerebrum. Not improbably the attacks of the newly-evolved Cynodont or mammalian type brought about a corresponding evolution in the Pseudosuchian Thecodonts which ultimately resulted in the formation of Dinosaurs and Birds." Broom, R., Proc. Roy. Soc., B., 87, p. 88.

jungle-fowl. So we are taught; but try to reconstruct the steps in their evolution and you realise your hopeless ignorance. To be sure there are breeds, such as black-red game and brown leghorns, which have the colours of the jungle-fowl, though they differ in shape and other respects. As we know so little as yet of the genetics of shape, let us assume that those transitions could be got over. Suppose, further, as is probable, that the absence of the maternal instinct in the leghorn is due to loss of one factor which the jungle-fowl possesses. So far we are on fairly safe ground. But how about white leghorns? Their origin may seem easy to imagine, since white varieties have often arisen in well-authenticated cases. But the white of white leghorns is not, as white in nature often is, due to the loss of the colour-elements, but to the action of something which inhibits their expression. Whence did that something come? The same question may be asked respecting the heavy breeds, such as Malays or Indian game. Each of these is a separate introduction from the East. To suppose that these, with their peculiar combs and close feathering, could have been developed from pre-existing European breeds is very difficult. On the other hand, there is no wild species now living any more like them. We may, of course, postulate that there was once such a species, now lost. That is quite conceivable, though the suggestion is purely speculative. I might thus go through the list of domesticated animals and plants of ancient origin and again and again we should be driven to this suggestion, that many of their distinctive characters must have been derived from some wild original now lost. Indeed, to this unsatisfying conclusion almost every careful writer on such subjects is now reduced. If we turn to modern evidence the case looks even worse. The new breeds of domestic animals made in recent times are the carefully selected products of recombination of pre-existing breeds. Most of the new varieties of cultivated plants are the outcome of deliberate crossing. There is generally no doubt in the matter. We have pretty full histories of these crosses in gladiolus, orchids, cineraria, begonia, calceolaria, pelargonium, etc. A very few certainly arise from a single origin. The sweet pea is the clearest case, and there are others which I should name with hesitation. The cyclamen is one of them, but we know that efforts to cross cyclamens were made early in the cultural history of the plant, and they may very well have been successful. Several plants for which single origins are alleged, such as the Chinese primrose, the dahlia, and tobacco, came to us in an already domesticated state, and their origins remain altogether mysterious. Formerly single origins were generally presumed, but at the present time numbers of the chief products of domestication, dogs, horses, cattle, sheep, poultry, wheat, oats, rice, plums, cherries, have in turn been accepted as "polyphyletic" or, in other words, derived from several distinct forms. The reason that has led to these judgments is that the distinctions between the chief varieties can be traced as far back as the evidence reaches, and that these distinctions are so great, so far transcending anything that we actually know variation capable of effecting, that it seems pleasanter to postpone the difficulty, relegating the critical differentiation to some misty antiquity into which we shall not be asked to penetrate. For it need scarcely be said that this is mere procrastination. If the origin of a form under domestication is hard to imagine, it becomes no easier to conceive of such enormous deviations from type coming to pass in the wild state. Examine any two thoroughly distinct species which meet each other in their distribution, as, for instance, *Lychnis diurna* and *vespertina* do. In areas of overlap are many intermediate forms. These used to be taken to be transitional steps, and the specific distinctness of *vespertina* and *diurna* was on that account questioned. Once it is known that these supposed intergrades are merely mongrels between the two species the transition from one to the other is practically beyond our powers of imagination to conceive. If both these can survive, why has their common parent perished? Why when they cross do they not reconstruct it instead of producing partially sterile hybrids? I take this example to show how entirely the facts were formerly misinterpreted.

When once the idea of a true-breeding—or, as we say, homozygous—type is grasped, the problem of variation becomes an insistent oppression. What can make such a type vary? We know, of course, one way by which novelty can be introduced—by crossing. Cross two well-marked varieties—for instance, of Chinese Primula—each breeding true, and in the second generation by mere recombination of the various factors which the two parental types severally introduced, there will be a profusion of forms, utterly unlike each other, distinct also from the original parents. Many of these can be bred true, and if found wild would certainly be described as good species. Confronted by the difficulty I have put before you, and contemplating such amazing polymorphism in the second generation from a cross in Antirrhinum, Lotsy has lately with great courage suggested to us that all variation may be due to such crossing. I do not disguise my sympathy with this effort. After the blind complacency of conventional evolutionists it is refreshing to meet so frank an acknowledgment of the hardness of the problem. Lotsy's utterance will at least do something to expose the artificiality of systematic zoology and botany. Whatever might or might not be revealed by experimental breeding, it is certain that without such tests we are merely guessing when we profess to distinguish specific limits and to declare that this is a species and that a variety. The only definable unit in classification is the homozygous form which breeds true. When we presume to say that such and such differences are trivial and such others valid, we are commonly embarking on a course for which there is no physiological warrant. Who could have foreseen that the apple and the pear—so like each other that their botanical differences are evasive—could not be crossed together, though species of Antirrhinum so totally unlike each other as *majus* and *molle* can be hybridised, as Baur has shown, without a sign of impaired fertility? Jordan was perfectly right. The true-breeding forms which he distinguished in such multitudes are real entities, though the great systematists, dispensing with such laborious analysis, have pooled them into arbitrary Linnean species, for the convenience of collectors and for the simplification of catalogues. Such pragmatical considerations may mean much in the museum, but with them the student of the physiology of variation has nothing to do. These "little species," finely cut, true-breeding, and innumerable mongrels between them, are what he finds when he examines any so-called variable type. On analysis the semblance of variability disappears, and the illusion is shown to be due to segregation and recombination of series of factors on pre-determined lines. As soon as the "little species" are separated out they are found to be fixed. In face of such a result we may well ask with Lotsy, is there such a thing as spontaneous variation anywhere? His answer is that there is not.

Abandoning the attempt to show that positive factors can be added to the original stock, we have further to confess that we cannot often actually prove variation by loss of factor to be a real phenomenon. Lotsy doubts whether even this phenomenon occurs. The sole source of variation, in his view, is crossing. But here I think he is on unsafe ground. When a well-established variety like "Crimson King" Primula, bred by Messrs. Sutton in thousands of individuals, gives off, as it did a few years since, a salmon-coloured variety, "Coral King," we might claim this as a genuine example of variation by loss. The new variety is a simple recessive. It differs from "Crimson King" only in one respect, the loss of a single colour-factor, and, of course, bred true from its origin. To account for the appearance of such a new form by any process of crossing is exceedingly difficult. From the nature of the case there can have been no cross since "Crimson King" was established, and hence the salmon must have been concealed as a recessive from the first origin of that variety, even when it was represented by very few individuals, probably only by a single one. Surely, if any of these had been heterozygous for salmon this recessive could hardly have failed to appear during the process of self-fertilisation by which the stock would be multiplied, even though that selfing may not have been strictly carried out. Examples like this seem to me practically conclusive.[5] They can be challenged, but not, I think, successfully. Then again in regard to those variations in number and division of parts which we call meristic, the reference of these to original cross-breeding is surely barred by the circumstances in which they often occur. There remain also the rare examples mentioned already in which a single wild origin may with much confidence be assumed. In spite of repeated trials, no one has yet succeeded in crossing the Sweet Pea with any other leguminous species. We know that early in its cultivated history it produced at least two marked varieties which I can only conceive of as spontaneously arising, though, no doubt, the profusion of forms we now have was made by the crossing of those original varieties. I mention the Sweet Pea thus prominently for another reason, that it introduces us to another though subsidiary form of variation, which may be described as a *fractionation* of factors. Some of my Mendelian colleagues have spoken of genetic factors as permanent and indestructible. Relative permanence in a sense they have, for they commonly come out unchanged after segregation. But I am satisfied that they may occasionally undergo a quantitative disintegration, with the consequence that varieties are produced intermediate between the integral varieties from which they were derived. These disintegrated conditions I have spoken of as subtraction—or reduction—stages. For example, the Picotee Sweet Pea, with its purple edges, can surely be nothing but a condition produced by the factor which ordinarily makes the fully purple flower, quantitatively diminished. The pied animal, such as the Dutch rabbit, must similarly be regarded as the result of partial defect of the chromogen from which the pigment is formed, or conceivably of the factor which effects its oxidation. On such lines I think we may with great confidence interpret all those intergrading forms which breed true and are not produced by factorial interference.

It is to be inferred that these fractional degradations are the consequence of irregularities in segregation. We constantly see irregularities in the ordinary meristic processes, and in the distribution of somatic differentiation. We are familiar with half segments, with imperfect twinning, with leaves partially petaloid, with petals partially sepaloid. All these are evidences of departures from the normal regularity in the rhythms of repetition, or in those waves of differentiation by which the qualities are sorted out among the parts of the body. Similarly, when in segregation the qualities are sorted out among the germ-cells in certain critical cell-divisions, we cannot expect these differentiating divisions to be exempt from the imperfections and irregularities which are found in all the grosser divisions that we can observe. If I am right, we shall find evidence of these irregularities in the association of unconformable numbers with the appearance of the novelties which I have called fractional. In passing let us note how the history of the sweet pea belies those ideas of a continuous evolution with which we had formerly to contend. The big varieties came first. The little ones have arisen later, as I suggest by fractionation. Presented with a collection of modern sweet peas how prettily would the devotees of continuity have arranged them in a graduated series, showing how every intergrade could be found, passing from the full colour of the wild Sicilian species in one direction to white, in the other to the deep purple of "Black Prince," though happily we know these two to be among the earliest to have appeared.

Having in view these and other considerations which might be developed, I feel no reasonable doubt that though we may have to forgo a claim to variations by addition of factors, yet variation both by loss of factors and by fractionation of factors is a genuine phenomenon of contemporary nature. If, then, we have to dispense, as seems likely, with any addition from without we must begin seriously to consider whether the course of evolution can at all reasonably be represented as an unpacking of an original complex which contained within itself the whole range of diversity which living things present. I do not suggest that we should come to a judgment as to what is or is not probable in these respects. As I have said already, this is no time for devising theories of evolution, and I propound none. But as we have got to recognise that there has been an evolution, that somehow or other the forms of life have arisen from fewer forms, we may as well see whether we are limited to the old view that evolutionary progress is from the simple to the complex, and whether after all it is conceivable that the process was the other way about. When the facts of genetic discovery become familiarly known to biologists, and cease to be the preoccupation of a few, as they still are, many and long discussions must inevitably arise on the question, and I offer these remarks to prepare the ground. I ask you simply to open your minds to this possibility. It involves a certain effort. We have to reverse our habitual modes of thought. At first it may seem rank absurdity to suppose that the primordial form or forms of protoplasm could have contained complexity enough to produce the divers types of life. But it is easier to imagine that these powers could have been conveyed by extrinsic additions? Of what nature could these additions be? Additions of material cannot surely be in question. We are told that salts of iron in the soil may turn a pink hydrangea blue. The iron cannot be passed on to the next generation. How can the iron multiply itself? The power to assimilate the iron is all that can be transmitted. A disease-producing organism like the pebrine of silkworms can in a very few cases be passed on through the germ-cells. Such an organism can multiply and can produce its characteristic effects in the next generation. But it does

[5] The numerous and most interesting "mutations" recorded by Prof. T. H. Morgan and his colleagues in the fly, Drosophila, may also be cited as unexceptionable cases.

not become part of the invaded host, and we cannot conceive it taking part in the geometrically ordered processes of segregation. These illustrations may seem too gross; but what refinement will meet the requirements of the problem, that the thing introduced must be, as the living organism itself is, capable of multiplication and of subordinating itself in a definite system of segregation? That which is conferred in variation must rather itself be a change, not of material, but of arrangement, or of motion. The invocation of additions extrinsic to the organism does not seriously help us to imagine how the power to change can be conferred, and if it proves that hope in that direction must be abandoned, I think we lose very little. By the re-arrangement of a very moderate number of things we soon reach a number of possibilities practically infinite.

That primordial life may have been of small dimensions need not disturb us. Quantity is of no account in these considerations. Shakespeare once existed as a speck of protoplasm not so big as a small pin's head. To this nothing was added that would not equally well have served to build up a baboon or a rat. Let us consider how far we can get by the process of removal of what we call "epistatic" factors, in other words those that control, mask, or suppress underlying powers and faculties. I have spoken of the vast range of colours exhibited by modern sweet peas. There is no question that these have been derived from the one wild bi-colour form by a process of successive removals. When the vast range of form, size, and flavour to be found among the cultivated apples is considered it seems difficult to suppose that all this variety is hidden in the wild crab-apple. I cannot positively assert that this is so, but I think all familiar with Mendelian analysis would agree with me that it is probable, and that the wild crab contains presumably inhibiting elements which the cultivated kinds have lost. The legend that the seedlings of cultivated apples become crabs is often repeated. After many inquiries among the raisers of apple seedlings I have never found an authentic case—once only even an alleged case, and this on inquiry proved to be unfounded. I have confidence that the artistic gifts of mankind will prove to be due not to something added to the make-up of an ordinary man, but to the absence of factors which in the normal person inhibit the development of these gifts. They are almost beyond doubt to be looked upon as *releases* of powers normally suppressed. The instrument is there, but it is "stopped down." The scents of flowers or fruits, the finely repeated divisions that give its quality to the wool of the merino, or in an analogous case the multiplicity of quills to the tail of the fantail pigeon, are in all probability other examples of such releases. You may ask what guides us in the discrimination of the positive factors and how we can satisfy ourselves that the appearance of a quality is due to loss. It must be conceded that in these determinations we have as yet recourse only to the effects of dominance. When the tall pea is crossed with the dwarf, since the offspring is tall we say that the tall parent passed a factor into the cross-bred which makes it tall. The pure tall parent had two doses of this factor; the dwarf had none; and since the cross-bred is tall we say that one dose of the dominant tallness is enough to give the full height. The reasoning seems unanswerable. But the commoner result of crossing is the production of a form intermediate between the two pure parental types. In such examples we see clearly enough that the full parental characteristics can only appear when they are homozygous—formed from similar germ-cells, and that one dose is insufficient to produce either effect fully. When this is so we can never be sure which side is positive and which negative. Since, then, when dominance is incomplete we find ourselves in this difficulty, we perceive that the amount of the effect is our only criterion in distinguishing the positive from the negative, and when we return even to the example of the tall and dwarf peas the matter is not so certain as it seemed. Professor Cockerell lately found among thousands of yellow sunflowers one which was partly red. By breeding he raised from this a form wholly red. Evidently the yellow and the wholly red are the pure forms, and the partially red is the heterozygote.

We may then say that the yellow is YY with two doses of a positive factor which inhibits the development of pigment; the red is yy, with no dose of the inhibitor; and the partially red are Yy, with only one dose of it. But we might be tempted to think the red was a positive characteristic, and invert the expressions, representing the red as RR, the partly red as Rr, and the yellow as rr. According as we adopt the one or the other system of expression we shall interpret the evolutionary change as one of loss or as one of addition. May we not interpret the other apparent new dominants in the same way? The white dominant in the fowl or in the Chinese primula can inhibit colour. But may it not be that the original coloured fowl or primula had two doses of a factor which inhibited this inhibitor? The Pepper moth, *Amphidasys betularia*, produced in England about 1840 a black variety, then a novelty, now common in certain areas, which behaves as a full dominant. The pure blacks are no blacker than the cross-bred. Though at first sight it seems that the black *must* have been something added, we can without absurdity suggest that the normal is the term in which two doses of inhibitor are present, and that in the absence of one of them the black appears.

In spite of seeming perversity, therefore, we have to admit that there is no evolutionary change which in the present state of our knowledge we can positively declare to be not due to loss. When this has been conceded it is natural to ask whether the removal of inhibiting factors may not be invoked in alleviation of the necessity which has driven students of the domestic breeds to refer their diversities to multiple origins. Something, no doubt, is to be hoped for in that direction, but not until much better and more extensive knowledge of what variation by loss may effect in the living body can we have any real assurance that this difficulty has been obviated. We should be greatly helped by some indication as to whether the origin of life has been single or multiple. Modern opinion is, perhaps, inclining to the multiple theory, but we have no real evidence. Indeed, the problem still stands outside the range of scientific investigation, and when we hear the spontaneous formation of formaldehyde mentioned as a possible first step in the origin of life, we think of Harry Lauder in the character of a Glasgow schoolboy pulling out his treasures from his pocket—"That's a wassher—for makkin' motor cars"!

As the evidence stands at present all that can be safely added in amplification of the evolutionary creed may be summed up in the statement that variation occurs as a definite event often producing a sensibly discontinuous result; that the succession of varieties comes to pass by the elevation and establishment of sporadic groups of individuals owing their origin to such isolated events; and that the change which we see as a nascent variation is often, perhaps always, one of loss. Modern research lends not the smallest encouragement or sanction to the view that gradual evolution occurs by the transformation of masses of individuals, though that fancy has fixed itself on popular imagination. The isolated events to which variation is due are evidently changes in the germinal tissues, probably in the manner in which they divide. It is likely that the occurrence of these variations is wholly irregular, and as to their causation we are absolutely without surmise or even plausible speculation. Distinct types once arisen, no doubt a profusion of the forms called species have been derived from them by simple crossing and subsequent recombination. New species may be now in course of creation by this means, but the limits of the process are obviously narrow. On the other hand, we see no changes in progress around us in the contemporary world which we can imagine likely to culminate in the evolution of forms distinct in the larger sense. By intercrossing dogs, jackals, and wolves new forms of these types can be made, some of which may be species, but I see no reason to think that from such material a fox could be bred in indefinite time, or that dogs could be bred from foxes.

Whether science will hereafter discover that certain groups can by peculiarities in their genetic physiology be declared to have a prerogative quality justifying their recognition as species in the old sense, and that the differences of others are of such a subordinate degree that they may in contrast be termed varieties, further genetic research alone can show. I myself anticipate that such a discovery will be made, but I cannot defend the opinion with positive conviction.

Somewhat reluctantly, and rather from a sense of duty, I have devoted most of this address to the evolutionary aspects of genetic research. We cannot keep these things out of our heads, though somtimes we wish we could. The outcome, as you will have seen, is negative, destroying much that till lately passed for gospel. Destruction may be useful, but it is a low kind of work. We are just about where Boyle was in the seventeenth century. We can dispose of alchemy, but we cannot make more than a quasi-chemistry. We are awaiting our Priestley and our Mendeléeff. In truth it is not these wider aspects of genetics that are at present our chief concern. They will come in their time. The great advances of science are made like those of evolution, not by imperceptible mass-improvement, but by the sporadic birth of penetrative genius. The journeymen follow after him, widening and clearing up, as we are doing along the track that Mendel found.

SECTION A.

MATHEMATICS AND PHYSICS.

Opening Address by Prof. F. T. Trouton, M.A., Sc.D., F.R.S., President of the Section.

We have lost since the last meeting of the Section several distinguished members who have in the past added so much to the usefulness of our discussions. These include Sir Robert Ball, who was one of our oldest attendants, and was president of the section at the Manchester meeting in 1886; Prof. Poynting, who was president of the section at Dover in 1899; and Sir David Gill, who was president of the Association at Leicester in 1907.

It seems appropriate at this meeting in the City of Melbourne to mention one who passed away from his scientific labours somewhat previous to the last meeting. I allude to W. Sutherland of this city, whose writings have thrown so much light on molecular physics and whose scientific perspicacity was only equalled by his modesty.

This meeting of the British Association will be a memorable one as being indicative, as it were, of the scientific coming of age of Australia. Not that the maturity of Australian science was unknown to those best able to judge, indeed the fact could not but be known abroad, for in England alone there are many workers in science hailing from Australia and New Zealand, who have enhanced science with their investigations and who hold many important scientific posts in that country. In short, one finds it best nowadays to ask of any young investigator if he comes from the Antipodes.

This speaks well for the universities and their staffs, who have so successfully set the example of scientific investigation to their pupils.

Radio-activity and kindred phenomena seem to have attracted them most of late years, and it would perhaps have been appropriate to have shortly reviewed in this address our knowledge in these subjects, to which the sons of Australasia have so largely contributed.

Twenty-five years ago FitzGerald and others were speculating on the possibility of unlocking and utilising the internal energy of the atom. Then came the epoch-making discovery of Becquerel, to be followed by the brilliant work of Rutherford and others showing us that no key was required to unlock this energy, the door lay open.

We have still facing us the analogous case of a hitherto untapped source of energy arising from our motion through the ether. All attempts, it is true, to realise this have failed, but nevertheless he would be a brave prophet who would deny the possibility of tapping this energy despite the ingenious theories of relativity which have been put forward to explain matters away. There is no doubt but that up to the present nothing hopeful has been accomplished towards reaching this energy and there are grave difficulties in the way; but "Relativity" is, as it were, merely trying to remove the lion in the path by laying down the general proposition that the existence of lions is an impossibility. The readiness with which the fundamental hypotheses of "Relativity" were accepted by many is characteristic of present-day physics, or perhaps more correctly speaking is an exaggerated example of it.

Such an acceptance as this could hardly be thought of as taking place half-a-century ago when a purely dynamical basis was expected for the full explanation of all phenomena, and when facts were only held to be completely understood if amenable to such treatment; while, if not so, they were put temporarily into a kind of suspense account waiting the time when the phenomenon would succumb to treatment based on dynamics.

Many things, perhaps not the least among them radio-activity, have conspired to change all this and to produce an attitude of mind prepared to be content with a much less rigid basis than would have been required by the natural philosophers of a past generation. These were the sturdy Protestants of science, to use an analogy, while we of the present day are much more catholic in our scientific beliefs, and in fact it would seem that nowadays to be used to anything is synonymous with understanding it.

Leaving, however, these interesting questions, I will confine my remarks to a rather neglected corner of physics, namely to the phenomena of absorption and adsorption of solutions. The term adsorption was introduced to distinguish between absorption which takes place throughout the mass of the absorbing material and those cases in which it takes place only over its surface. If, for instance, glass, powdered so as to provide a large surface, is introduced into a solution of a salt in water, we have in general some of the salt leaving the body of the solution and adhering in one form or other to the surface of the glass. It is to this the term adsorption has been applied. Physicists have now begun to take up the question seriously, but it was to biologists and especially physiological chemists that most of our knowledge of the subject in the past was due, the phenomenon being particularly attractive to them, seeing that so many of the processes they are interested in take place across surfaces.

As far as investigations already made go, the laws of adsorption appear to be very complicated, and no doubt many of the conflicting experimental results which have been obtained are in part due to this, workers under somewhat different conditions obtaining apparently contradictory effects.

On the whole, however, it may be said that the amount adsorbed increases with the strength of solution according to a simple power law, and diminishes with rise of temperature; but there are many exceptions to these simple rules. For instance, in the case of certain sulphates and nitrates the amount adsorbed by the surface of, say, precipitated silica, only increases up to a certain critical point as the strength of the solution is increased. Then further increase in the strength of the solution causes the surface to give up some of the salt it has already adsorbed or the amount adsorbed is actually less now than that adsorbed from weaker solutions. Beyond this stage for still greater concentrations of the solutions the amount adsorbed goes on increasing as before the critical point was reached.

There is some reason for thinking that there are two modes in which the salt is taken up or adsorbed by the solid surface. The first of them results from a simple strengthening of the solution in the surface layers; the second, which takes place with rather stronger concentrations, is a deposition in what is apparently analogous to the solid form. It would seem that the first reaches out from the solid surface to about 10^{-8} cm.—which is the order of the range of attraction of the particles of the solid substance.

The cause of the diminution in the adsorption layer at a certain critical value of the concentration is difficult to understand. Something analogous has been observed by Lord Rayleigh in the thickness of layers of oil floating on the surface of water. As oil is supplied the thickness goes on increasing up to a certain point, beyond this, on further addition of oil, the layer thins itself at some places and becomes much thicker at others, intermediate thicknesses to these being apparently unstable and unable to exist. As helping towards an explanation of the diminution in the adsorption layer, we may suppose that as the strength of the solution is increased from zero, the adsorption is at first merely an increased density of the solution in the surface layer. For some reason, after this has reached a certain limit, further addition of salt to the solution renders this mode of composition of the surface layers unstable, and there is a breaking up of the arrangement of the layer with a diminution in its amount. We may now suppose the second mode of deposition to begin to show its effect with a recovery in the amount of the surface layers and a further building up of the adsorption deposits.

On account of passing through this point of instability the process is irreversible, so that the application of thermo-dynamics to the phenomenon of adsorption is necessarily greatly restricted in its usefulness.

A possible cause of the instability in the adsorption layer which occurs at the critical point may be looked for in the alternations in the sign of the mutual forces between attracting particles of the kind suggested by Lord Kelvin and others. Within a certain distance apart—the molecular range—the particles of matter mutually attract one another, while at very close distances they obviously must repel, for two particles refuse to occupy the same space. At some intermediate distances the force must pass through zero value. It has for various reasons been thought that, in addition, the force has zero value at a second distance lying between the first zero and the molecular range, with accompanying alternations in the sign of the force. Thus, starting from zero distance apart of the particles, the sign of the force is negative or repulsive; then, as the distance apart is supposed to increase, the force of repulsion diminishes, and after passing through zero value becomes positive or attractive; next, as the distance is increased, the force diminishes again, and after passing through a second zero becomes negative for a second time; finally, the force on passing through a third zero becomes positive, and is then in the stage dealt with in capillary and other questions.

As an instance, of where these alternations of sign seem to be manifest, may be mentioned the case of certain crystals when split along cleavage planes. The split often runs along further than the position of the splitting instrument or inserted wedge seems to warrant. This would occur if the particles on either side of the cleavage plane were situated at the distance apart where the force between them was in the first attractive condition, for then on increasing the distance between the particles by means of the wedge the force changes sign and becomes repulsive, thus helping the splitting to be propagated further out.

Assuming that a repulsive force can supervene between the particles in the adsorption layer, through the particles becoming so crowded in places as to reduce their mutual distances to the stage when repulsion sets in, we might expect that an instability would be set up.

As already stated, a rise in temperature reduces in general the amount adsorbed, but below the critical point the nitrates and sulphates are exceptional, for rise in temperature here increases the amount adsorbed from a given solution. This obviously necessitates that the isothermals cross one another at the critical point in an adsorption-concentration diagram. This may perhaps account for some observers finding that adsorption did not change with temperature. We have another exception to the simple laws of adsorption in the case of the alkali chlorides; this exception occurs under certain conditions of temperature and strength of solution. The normal condensation into the surface layer is reversed and the salt is repelled into the general solution instead of being attracted by the surface. In other words, it is the turn of the other constituent of the solution, namely, the water, to be adsorbed.

It is a very well known experiment in adsorption to run a solution such as that of permanganate of potash through a filter of sand, or, better, one of precipitated silica, so as to provide a very large surface. The first of the solution to come through the filter has practically lost all its salt owing to having been adsorbed by the surface of the sand.

I was interested in finding a few months ago that Defoe, the author of "Robinson Crusoe," in one of his other books, depicts a party of African travellers as being saved from thirst in a place where the water was charged with alkali by filtering the water through bags of sand. Whether this is a practical thing or not is doubtful, or even if it has ever been tried; for it is only the first part of the liquid to come through the filter which is purified, and very soon the surface has taken up all the salt it can adsorb, and after that, of course, the solution comes through intact. It is interesting, however, to know that so long ago as Defoe's time the phenomenon of adsorption from salt solutions had been observed. It is not so well known that in the case of some salts under the circumstances mentioned above, the first of the solution to come through the sand filter is stronger instead of weaker. This, as already mentioned, is because water, or at least a weaker solution, forms the adsorption layer.

Most of the alkali chlorides as the temperature is raised show this anomalous adsorption, provided the strength of the solution is below a certain critical value differing for each temperature. For strengths of solution above these values the normal phenomenon takes place.

No investigations seem to have been made on the effect of pressure on adsorption. These data are much to be desired.

The investigation of adsorption and absorption should throw light on osmosis, as in the first place the phenomenon occurs across a surface necessarily covered with an adsorption layer, and in the second place, as we shall see, the final condition is an equilibrium between the absorption of water by the solution and that by the membrane.

The study of the conditions of absorption of water throughout the mass of the colloidal substance of which osmotic membranes are made is of much interest. Little work has been done on the subject as yet, but what little has been done is very promising.

It is convenient to call the material of which a semi-permeable membrane is made the semi-permeable medium. The ideal semi-permeable medium will not absorb any salt from the solution but only water, but such perfection is probably seldom to be met with. If a semi-permeable medium such as parchment paper be immersed in a solution, say, of sugar, less water is taken up or absorbed than is the case when the immersion is in pure water. The diminution in the amount absorbed is found to increase with the strength of the solution. It is at the same time found that the absorption or release of water by the semi-permeable medium according as the solution is made weaker or stronger is accompanied by a swelling or shrinkage greater than can be accounted for by the water taken up or rejected.

The amount of water absorbed by a semi-permeable medium from a solution is found by experiment to depend upon the hydrostatic pressure. If the pressure be increased the amount of water absorbed by the semi-permeable medium is increased. It is always thus possible by the application of pressure to force the semi-permeable medium to take up from a given solution as much water as it takes up from pure water at atmospheric pressure.

It is not possible for a mass of such a medium to be simultaneously in contact and in equilibrium with both pure water and with a solution all at one and the same pressure, seeing that the part of the medium in contact with the pure water would hold more water than that part in contact with the solution and consequently diffusion would take place through the mass of the medium.

If, however, the medium be arranged so as to separate the solution and the water and provided the medium is capable of standing the necessary strain, it is possible to increase the pressure of the solution without increasing the pressure of the water on the other side. Thus the part of the medium which is in contact with the solution is at a higher pressure than that part in contact with the pure solvent; consequently the medium can be in equilibrium with both the solution and the solvent, for if the pressures are rightly adjusted the moisture throughout the medium is everywhere the same.

The ordinary arrangement for showing osmotic pressure is a case such as we are considering, and equilibrium throughout the membrane is only obtained when the necessary difference in pressure exists between the two sides of the membrane.

This condition would eventually be reached no matter how thick the membrane was. It is sometimes helpful to think of the membrane as being very thick. It precludes any temptation to view molecules as shooting across from one liquid to the other through some kind of peep-holes in the membrane.

The advantage in a thin membrane in practice is simply that the necessary moisture is rapidly applied to the active surface, thus enabling the pressure on the side of the solution to rise quickly, but it has no effect on the ultimate equilibrium.

As far as that goes, the semi-permeable membrane or saturated medium might be infinitely thick, or, in other words, there need be no receptacle or place for holding the pure solvent outside the membrane at all. In fact, the function of the receptacle containing the pure solvent is only to keep the medium moist, and is no more or no less important than the vessel of water supplied to the gauze of the wet-bulb thermometer. It is merely to keep up the supply of water to the medium.

The real field where the phenomenon of osmosis takes place is the surface of separation between the saturated semi-permeable medium and the solution. Imagine a large mass of colloidal substance saturated with water and having a cavity containing a solution. The pressure will now tend to rise in the cavity until it reaches the osmotic pressure—that is, until there is established an equilibrium of surface transfer of molecules from the solution into the medium and back from the medium into the solution.

No doubt, the phenomenon as thus described occurs often in nature. It is just possible that the high-pressure liquid cavities, which mineralogists find in certain rock crystals, have been formed in some such manner in the midst of a mass of semi-permeable medium; the pure solvent in this case being carbon dioxide and the medium colloidal silica, which has since changed into quartz crystal.

In considering equilibrium between a saturated semi-permeable medium and a solution there seems to me to be a point which should be carefully considered before being neglected in any complete theory. That is, the adsorption layer over the surface of the semi-permeable medium. We have seen that solutions are profoundly modified in the surface layers adjoining certain solids, through concentration or otherwise of the salts in the surface layer, so that the actual equilibrium of surface transfer of water molecules is not between the unmodified solution and the semi-permeable medium, but between the altered solution in the absorption layer and the saturated medium. Actual determinations of the adsorption by colloids are much wanted, so as to be able to be quite sure of what this correction amounts to or even if it exists. It may turn out to be zero. If there is adsorption, however, it may possibly help to account for part of the unexpectedly high values of the osmotic pressure observed at high concentrations of the solution, the equilibrium being, as we have seen, between the saturated medium and a solution of greater concentration than the bulk of the liquid, namely, that of the adsorption layer. In addition, when above the critical adsorption point, there may be a deposit in the solid state. This may produce a kind of polarised equilibrium of surface transfer in which the molecules which discharge from the saturated medium remain unaltered in amount, but those which move back from the adsorption layer are reduced owing to this deposit, thus necessitating an increase in pressure for equilibrium. If either or both of these effects really exist, it would seem to require that the pressure should be higher for equilibrium of the molecular surface transfer than if there were no adsorption layer and the unaltered solution were to touch the medium, but at the same time it should be remembered that there is a second surface where equilibrium must also exist—that is, the surface of separation of the adsorption layer and the solution itself. It is just possible that the two together cancel each other's action.

Quantitative determinations of absorption by solid media from solution are hard to carry out, but with a liquid medium it is not so difficult. Ether constitutes an excellent semi-permeable medium for use with sugar solution, because it takes up or dissolves only a small quantity of water and no sugar. A series of experiments using these for medium and solution has shown (1) that the absorption of water from a solution diminishes with the strength of the solution; and (2) that the absorption of water for any given strength of solution increases with the pressure. This increase with pressure is somewhat more rapid than if it were in proportion to the pressure. On the other hand, from pure water ether absorbs in excess of normal almost in proportion to the pressure. Certainly this is so up to 100 atmospheres. This would go to confirm the suggestion already made that the departure from proportionality in the osmotic pressure is attributable to absorption.

By applying pressure ether can be thus made to take up the same quantity of water from any given solution as it takes up from pure water at atmospheric pressure. It is found by experiment that this pressure is the osmotic pressure proper to the solution in question.

Decidedly the most interesting fact connected with the whole question of osmotic pressure, the behaviour of vapour pressures from solution, and the equilibrium of molecular transfer of solutions with colloids, is that discovered by van 't Hoff, that the hydrostatic pressure in question is equal to what would be produced by a gas having the same number of particles as those of the introduced salt. Take the case of a mass of colloid or semi-permeable medium placed in a vessel of water; the colloid when in equilibrium at atmospheric pressure holds what we will call the normal moisture. By increasing the pressure this moisture can be increased to any desired amount. Now, on introducing salt the moisture in the colloid can be reduced at will. The question is, what quantity of salt must be introduced just to bring back the amount of the moisture in the colloid to normal? Here we get a great insight into the internal mechanism of the liquid state. The quantity of salt required turns out to be, approximately at least, that amount which if in the gaseous state would produce the pressure. So that normality can be either directly restored by removing the pressure or indirectly by introducing salt in quantity which just takes up the applied pressure. That this is so naturally suggested that the salt, although compelled to remain within the confines of the liquid, nevertheless produces the same molecular bombardment as it would were it in the gaseous state, though, of course, the free path must be viewed as enormously restricted compared with that in the gaseous state.

Many have felt a difficulty in accepting this view of a molecular bombardment occurring in the liquid state, but of recent years much light has been thrown on the subject of molecular movements in liquids, especially by Perrin's work, so that much of the basis of this difficulty may be fairly considered as now removed.

Quite analogous to the reduction from the normal of the moisture held by a semi-permeable medium brought about by the addition of salt to the water, is the reduction in the vapour pressure arising from the presence of a salt in the water. The vapour pressure is likewise increased by the application of hydrostatic pressure, which may be effected by means of an inert gas. In both cases the hydrostatic pressure which must be applied to bring back to normality is equal to that which the added salt would exert if it were in the state of vapour or, in other words, the osmotic pressure.

The two cases are really very similar. In both there is equal molecular transfer backwards and forwards across the bounding surface. In the one a transfer from that solution to the semi-permeable medium and back from it into the solution. In the other a transfer from the solution into the superambient vapour and back from it into the solution.

The processes are very similar, namely, equal molecular transfer to and fro across the respective surfaces of separation.

Thus we may in the case of osmotic equilibrium attribute the phenomenon with Callendar to evaporation, but not evaporation in its restricted sense, from a free surface of liquid, but as we have seen from a saturated colloidal surface into the solution. This process might perhaps be better referred to as molecular emigration, the term migration being already a familiar one in connection with liquid phenomena.

SECTION B.

CHEMISTRY.

Opening Address by Prof. William J. Pope, M.A., LL.D., F.R.S., President of the Section.

The British Association has been firmly established as one of the institutions of our Empire for more than half a century past. The powerful hold which it has acquired probably arises from the welcome which every worker in science extends to an occasional cessation of his ordinary routine—a respite during which the details of the specific inquiry in hand may be temporarily cast aside, and replaced by leisurely discussion with colleagues on the broader issues of scientific progress.

The investigator, continually occupied with his own problems and faced with an ever-increasing mass of technical literature, ordinarily finds little time for reflection upon the real meaning of his work; he secures, in general, far too few opportunities of considering in a philosophical sort of way the past, present, and future of his own particular branch of scientific activity. It is not difficult to form a fairly accurate survey of the position to which chemistry had attained a generation ago, perhaps even a few years ago; probably no intellect at present existing could pronounce judgment upon the present position of our science in terms which would commend themselves to the historian of the twenty-first century. Doubtless even one equipped with a complete knowledge of all that has been achieved, standing on the very frontier of scientific advance and peering into the surrounding darkness, would be quite incompetent to make any adequate forecast of the conquests which will be made by chemical and physical science during the next fifty years. At the same time, chemical history tells us that progress is the result in large measure of imperfect attempts to appreciate the present and to forecast the future. I therefore propose to lay before you a sketch of the present position of certain branches of chemical knowledge and to discuss the directions in which progress is to be sought; none of us dare cherish the conviction that his views on such matters are correct, but everyone desirous of contributing towards the development of his science must attempt an appreciation of this kind. The importance to the worker and to the subject of free ventilation and discussion of the point of view taken by the individual can scarcely be over-estimated.

The two sciences of chemistry and physics were at one time included as parts of the larger subject entitled natural philosophy, but in the early part of the nineteenth century they drew apart. Under the stimulus of Dalton's atomic theory, chemistry developed into a study of the interior of the molecule, and, as a result of the complication of the observed phenomena, progressed from stage to stage as a closely reasoned mass of observed facts and logical conclusions. Physics, less entangled in its infancy with numbers of experimental data which apparently did not admit of quantitative correlation, was developed largely as a branch of applied mathematics, such achievements of the formal physics of the last century as the mathematical theory of light and the kinetic theory of gases are monuments to the powers of the human intellect.

The path of chemistry, as an application of pure logical argument to the interpretation of complex masses of observations, thus gradually diverged from that taken by physics as the mathematical treatment of less involved experimental data, although both subjects derived their impetus to development from the speculations of genius.

It is interesting to note, however, that during recent years the two sciences, which were so sharply distinguished twenty years ago as to lead to mutual misunderstandings, are now converging. Many purely chemical questions have received such full quantitative study that the results are susceptible to attack by the methods of the mathematical physicist; on the other hand, the intense complication perceived during the fuller examination of many physical prolems, has led to their interpretation by the logical argument of the chemist because the traditional mathematical mode of attack of the phycisist has proved powerless to deal with the intricacies exhibited by the observed facts.

The progress of chemistry during the last century has been mainly the result of the coordination of observed facts in accordance with a series of hypotheses each closely related in point of time to the one preceding it. The atomic theory, as it was enunciated by Dalton in 1803, was a great impetus to chemical investigation, but proved insufficient to embrace all the known facts; it was supplemented in 1813 by Avogadro's theorem—that equal volumes of gases contain the same number of molecules at the same temperature and pressure. These two important theoretical developments led to the association of a definite physical meaning with the idea of molecular *composition*, but ultimately proved insufficient for the interpretation of the ever-increasing mass of chemical knowledge collected under their stimulus. A further great impetus followed the introduction by Frankland and Kekulé, in 1852 onwards, of the idea of valency and the mode of building up constitutional formulæ; the conception of molecular *constitution* thus arose as a refinement on the Daltonian notion of molecular composition. In course of time the theoretical scheme once more proved insufficient to accommodate the accumulated facts, until, in 1874, van 't Hoff and Le Bel demonstrated the all-important part which molecular *configuration* plays in the interpretation of certain classes of phenomena known to the organic chemist.

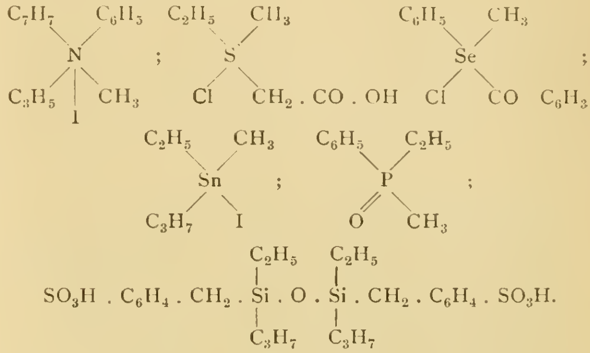
During the early days of chemical science—those of Dalton's time and perhaps also those of Frankland and Kekulé—we can believe that chemical theory may have lacked the physical reality which it now seems to us to present; the attitude of our predecessors towards the theoretical interpretation of their observations was rather that described by Plato: "as when men in a dark cavern judge of external objects by the shadows which they cast into the cavern." In the writings of the most clear-sighted of our forerunners we can detect an underlying suspicion of a possibility that, at some time or other, the theory by means of which chemical observations are held together may undergo an entire reconstruction; a very few years ago Ostwald made a determined attempt to treat our science without the aid of the molecular hypothesis, and indeed suggested the desirability of giving the Daltonian atomic theory decent burial.

The last ten years or so has seen a change in this attitude. The development of organic chemistry has revealed so complete a correspondence between the indications of the conception of molecular constitution and configuration and the observed facts, and recent work on the existence of the molecule, largely in connection with colloids, with radioactivity, and with crystal structure, is so free from ambiguity, that persistence of doubt seems unreasonable. Probably most chemists are prepared to regard the present doctrine of chemical constitution and configuration as proven; although they may turn a dim vision towards the next great development, they have few misgivings as to the stability of the position which has already been attained.

Let us consider how far the study of organic chemistry has hitherto led us; we may pass over the gigantic achievements of those who in past generations determined constitution and performed syntheses, thus making the subject one of the most perfect examples of scientific classification which exist, and turn to the question of molecular configuration. In 1815 Biot observed that certain liquid organic substances deflect the plane of polarisation of a transmitted ray of light either to the right or to the left; half a century later Pasteur and Paternò pointed the obvious conclusion, namely, that the right- or left-handed deviation thus exerted must be due to a corresponding right- or left-handedness in the configuration of the chemical molecule. A scheme representing such right- or left-handedness, or enantiomorphism, was first enunciated by van 't Hoff and Le Bel upon the basis of the previously established doctrine of chemical constitution; briefly stated, the idea suggesed was that the methane molecule, CH_4, was not to be regarded as extended in a plane in the manner represented by the Frankland-Kekulé constitutional formula, but as built up symmetrically in three-dimensional space. The carbon atom of the methane molecule thus occupies the centre of a regular tetrahedron, of which the apices are replaced by the four hydrogen atoms. A methane derivative, in which one carbon is separately attached to four different univalent atoms or radicles of the type CXYZW, should thus exist in two enantiomorphous configurations, one exhibiting right- and the other left-handedness. The inventors of this daringly mechanistic interpretation of the far less concrete constitutional formulæ were able to interpret immediately a large number of known facts, previously incomprehensible, by means of their extension of the Frankland-Kekulé view of constitution. They showed that every substance then known, which in the liquid state exhibited so-called optical activity, could be regarded as a derivative of methane in which the methane carbon atom was attached to four different univalent atoms or groups of atoms; a methane carbon atom so associated is termed an asymmetric carbon atom. It is of interest to note that the van 't Hoff-Le Bel deduction resulted from the discussion of the behaviour of organic substances of some molecular complexity; the optically active substances then known were mostly the products of animal or vegetable life, and among them none occurs which contains less than three carbon atoms in the molecule. Lactic acid, $CH_3.CH(OH).CO.OH$, is practically the most simple optically active substance of natural occurrence; it contains twelve atoms in the molecule, and it has only recently been found possible to associate optical activity with a much more simply constituted substance, namely, chloriodomethanesulphonic acid, $CHClI.SO_3H$, the molecule of which contains less than 5 per cent. of carbon and only nine atoms, four more than the minimum number, five, which theoretically can give rise to optical activity.[1]

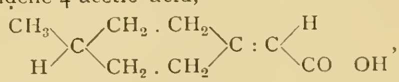
The working out of the practical consequences of the doctrine of the tetrahedral configuration of the methane carbon atom by von Baeyer, Emil Fischer, and Wislicenus is now a matter of history; the acquisition of masses of experimental data, broad in principle and minute in detail, placed the van 't Hoff-Le Bel hypothesis beyond dispute. The rapid growth of organic chemistry as a classified subject contrasted strongly with that of inorganic chemistry, in which the collection of a great variety of detailed knowledge incapable of far-reaching logical correlation formed the most striking feature; in fact, the extension of the conclusion, proven in the case of carbon compounds, that the Frankland-Kekulé constitutional formulæ must be translated into terms of three-dimensional space, to compounds of elements other than carbon, did not immediately follow the application of the theory to this element. Twenty years ago, indeed, the idea prevailed that carbon compounds differed radically from those of other elements, and we were not prepared to transfer theoretical conclusions from the organic to the inorganic side of our subject. In 1891, however, Le Bel stated that he had found optical activity associated wth asymmetry of a quinquevalent nitrogen atom; although the experimental work upon which this conclusion was founded is now known to be incorrect,[2] the conception thus put forward was important, as suggesting that the notion of space-configuration could not be restricted logically to methane derivatives. When it was proved in 1899 that benzylphenylallylmethylammonium iodide could exist in a right- and left-handed configuration, it became necessary to admit that the spacial arrangement of the parts of a chemical molecule, previously restricted to methane derivatives, must be extended to ammonium salts.[3]

The demonstration that optical activity, or enantiomorphism, of molecular configuration is associated not only with the presence of an asymmetric quadrivalent carbon atom, but also with that of a nitrogen atom attached to five different radicles, was the result of an improvement of technique in connection with the study of optical activity; previously the resolution into optically active components of a potentially optically active basic substance had been attempted with the aid of naturally occurring optically active weak acids of the general type of *d*-tartaric acid. The application of the strong *d*- and *l*-bromocamphorsulphonic acids and the *d*- and *l*-camphorsulphonic acids to such purposes rendered possible the isolation of the optically active substances containing no asymmetric atom other than one of quinquevalent nitrogen. The resolution of asymmetric quaternary ammonium salts of the kind indicated was rapidly followed by the preparation of optically active substances in which the enantiomorphism is associated with the presence of an asymmetric sulphur, selenium, tin, phosphorus, or silicon atom; compounds of the following constitutions were thus obtained in optically active modifications:—



In all this work, and amongst all the varied classes of optically active compounds prepared, it was in every instance possible to indicate one particular quadrivalent or quinquevalent atom in the molecule which is separately attached to four or five different atoms or radicles; the enantiomorphism of molecular configuration may be detected, in fact, by the observation that such an asymmetric atom is present. It must, however, be insisted that the observed optical activity is the result of the enantiomorphism of the molecular configuration; the asymmetry of a particular atom is not to be regarded as the cause of the optical activity, but merely as a convenient geometrical sign of molecular enantiomorphism. In 1874 van 't Hoff realised that molecular enantiomorphism and optical activity might conceivably exist without the presence of an asymmetric carbon atom, and suggested that compounds of the type

should be of this kind. Previously this particular case had escaped realisation experimentally, but an example fulfilling similar conditions was described in 1909; in this year the *d*- and *l*-isomerides of 1-methyl-*cyclo*hexylidene-4-acetic acid,



were obtained.[4] The consideration of the constitution of these substances shows no carbon atom which is attached to four different groups, but a study of the solid model representing the molecular configuration built up in accordance with the van 't Hoff-Wislicenus conclusions reveals the enantiomorphism.

It is of some importance to note that the configurations assigned to such optically active substances as have been mentioned above, on the basis of the experimental evidence, are of as symmetrical a character as the conditions permit; the Kekulé formula for methane, CH_4, in which all five atoms lie in the same plane, is not of so highly symmetrical a character as the van 't Hoff-Le Bel configuration in which the four hydrogen atoms are situate at the apices of a

[1] Pope and Read, Trans. Chem. Soc., 1914, 105, 811.
[2] *Ibid.*, 1912, 101, 519.
[3] Pope and Peachey, Trans. Chem. Soc., 1899, 75, 1127.
[4] Perkin, Pope, and Wallach, Trans. Chem. Soc., 1909, 95, 1789; Perkin and Pope, Trans. Chem. Soc., 1911, 99, 1510.

regular tetrahedron described about the carbon atom as centre. Some influence seems to be operative which tends to distribute the component radicles in an unsymmetrical molecule in as symmetrical a manner as possible; recent work indicates, however, that this is not always true. During the past few years Mills and Bain[5] have shown that the synthetic substance of the constitution

$$\begin{array}{c} CH_3 \\ H \end{array}\!\!>C<\!\!\begin{array}{cc} CH_2 & CH_2 \\ CH_2 & CH_2 \end{array}\!\!>C:N.OH$$

can be resolved into optically active modifications. The conclusion is thus forced upon us that the tri-valent nitrogen atom in such compounds is not environed in the most symmetrical manner possible by the surrounding components of the molecule; the experimental verification which the conclusions of Hantzsch and Werner, concerning the isomerism of the oximes, thus derive, constitutes the first really direct evidence justifying their acceptance.

Quite recently, and by the application largely of the optically active powerful sulphonic acids derived from camphor, Werner has made another great advance in connection with the subject of optical activity. He has obtained a number of complex compounds of chromium, cobalt, iron, and rhodium in optically active modifications.

The foregoing brief statement probably suffices to indicate the progress which has been made during the last twenty years in demonstrating that the atoms or radicles associated in the chemical molecule do not lie in one plane, but are disposed about certain constituent atoms in three-dimensional space; careful study of the present stage of progress shows that we must attribute to molecular configuration, as determined by modern chemical methods, a very real significance. It can no longer be supposed to possess the purely diagrammatic character which attached to the Frankland-Kekulé constitutional formulæ; it seems to be proved that the men who developed the doctrine of valency were not merely pursuing an empirical mode of classification, capable of various modes of physical interpretation, but were devising the main scheme of a correct mechanical model of the chemical universe.

The development of a branch of science such as that now under discussion is, to a considerable extent, an artistic pursuit; it calls for the exercise of manipulative skill, of a knowledge of materials, and of originality of conception, which probably originate in intuition and empiricism, but must be applied with scientific acumen and logical judgment. For reasons of this kind many gaps occur in our present knowledge of the subject; although so many important conclusions find an unshakable foundation on facts relating to optical activity, we have as yet no clear idea as to why substances of enantiomorphous molecular configuration exhibit optical activity. Great masses of quantitative data referring to optical activity have been accumulated; something has been done towards their correlation by Armstrong, Frankland, Pickard, Lowry, and others, but we still await from the mathematical physicist a theory of optical activity comparable in quantitative completeness to the electro-magnetic theory of light. Until we get such a theory it seems unlikely that much further progress will be made in interpreting quantitative determinations or rotation constants.

That aspect of stereochemistry which has just been so briefly reviewed represents a situation which has been attained during the natural development of organic chemistry by methods which have now become traditional; progress has been made by the application of strictly logical methods of interpretation to masses of experimental data, and each new conclusion has been checked and verified by the accumulation of fresh contributions in the laboratory. The sureness of the methods adopted could not fail to lead to the intrusion of stereochemistry into adjacent fields of scientific activity; bio-chemistry, the study of the chemical processes occurring in living organisms, is already largely dominated by stereochemistry, and the certainty with which stereochemistry has inspired us as to the reality of the molecular constitution of matter is exerting a powerful influence in other branches of natural science. Quite possibly, however, the acquaintance which every chemist possesses of the great progress already made upon one particular set of lines is to some extent an obstacle to his appreciation of new directions in which further great stereochemical advances may be anticipated.

A little reflection will show that the study of the relation between the crystalline form and chemical constitution or configuration of substances in general may confidently be expected to lead to important extensions of our knowledge of the manner in which the atoms are arranged in molecular complexes. The earlier crystallographic work of the nineteenth century led to the conclusion that each substance affects some particular crystalline form, that the regular external crystalline shape is an expression of the internal structure of the crystal, and that a determination of the simpler properties—geometrical, optical, and the like—of a crystalline material constitutes a mode of completely characterising the substance. Later work during the last century demonstrated that the properties of crystalline substances are in entire harmony with a simple assumption as to the manner in which the units or particles of the material are arranged; the assumption is that the arrangement is a geometrically "homogeneous" one, namely, an arrangement in which similar units are uniformly repeated throughout the structure, corresponding points presenting everywhere a similar environment. The assumption of homogeneity of structure imposes a definite limitation upon the kinds of arrangement which are possible in crystals; it leads to the inquiry as to how many types of homogeneous arrangement of points in space are possible, and to the identification of these types with the known classes of crystal symmetry. The final conclusion has been attained that there are 230 geometrically homogeneous modes of distributing units, or points representing material particles, throughout space; these, the so-called 230 homogeneous "point-systems," fall into the thirty-two types of symmetry exhibited by crystalline solids. The solution of the purely geometrical problem here involved was commenced by Frankenheim in 1830, and finally completed by Barlow in 1894; it brings us face to face with the much larger stereochemical problem—that of determining what the units are which become homogeneously arranged in the crystal, why they become so arranged, and in what way a connection can be established between chemical constitution and crystal structure.

Since the conception of homogeneity of structure alone is clearly insufficient for the interpretation of the more advanced problem, some further assumption must be made as a foundation for any really comprehensive attempt to collate the quantities of isolated facts bearing upon the subject. Of the many assumptions which have been made in this connection only one, which may now be stated, has as yet proved fruitful in the sense that it serves to correlate large numbers of known experimental facts, and that it

[5] Trans. Chem. Soc., 1910, 97, 1866.

indicates the way to the discovery of fresh facts. The assumption is that each atom in a crystalline structure acts as a centre of operation of two opposing forces: (*a*) a repellent force, attributable to the kinetic energy of the atom, and (*b*) an attractive force, both forces, like gravity, being governed by some inverse distance law. Such an assumption forms an essential part of the classical work of Clerk Maxwell and van der Waals on the kinetic theory of gases and liquids. Its application to solid crystalline substances, where it must be applied in conjunction with the principle of structural homogeneity, was made by Barlow and myself in 1906.

The operation of the assumption just stated is readily visualised by considering the simplest possible case, that, namely, of a crystalline element each molecule of which consists of but one atom and in which all the atoms are similar. Consideration of this kind of case shows that the set of identically similar centres

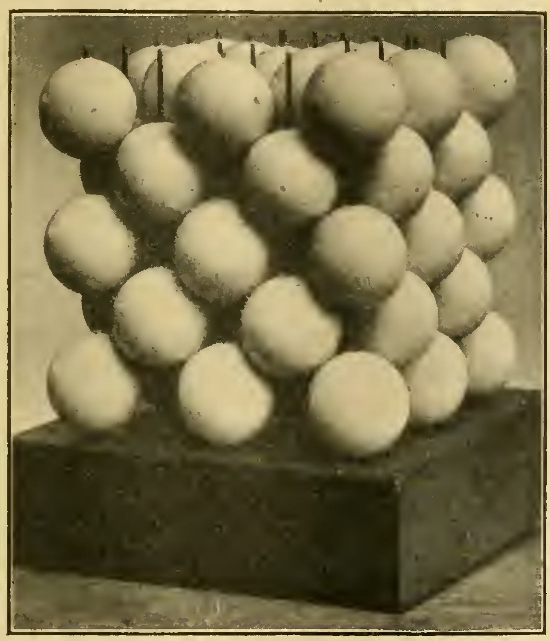


FIG. 1.

of attracting and opposing forces will be in equilibrium when one particular simple condition is fulfilled; the condition is that, with a given density of packing of the centres, the distance separating nearest centres is a maximum. Two homogeneous arrangements of points fulfil this condition, and these exhibit the symmetry of the cubic and the hexagonal crystalline systems.

Since the nature of the two arrangements of points is not easily realised by mere inspection, the systems must be presented in some alternative form for the purpose of more clearly demonstrating their properties; this is done conveniently by imagining each point in either arrangement to swell as a sphere until contact is made with the neighbouring points. The two arrangements then become those shown in Figs. 1 and 2, and are distinguished as the cubic and the hexagonal closest-packed assemblages of equal spheres; they differ from all other homogeneous arrangements in presenting maximum closeness of packing of the component spheres. The equilibrium condition previously remarked—that, with a given density of distribution of the force centres in space, the distance separating nearest centres is a maximum—is revealed in the assemblages of spheres as the condition that the spheres are arranged with the maximum closeness of packing.

A further step is yet necessary. Each point in the arrangements considered is regarded as the mean centre of an atom of the crystalline element, but the assumption originally made states nothing about the magnitude of the atom itself; it is therefore convenient to regard the whole of the available space as filled by the atoms, without interstices. This is conveniently done by imagining tangent planes drawn at each contact of sphere with sphere, so partitioning the available space into plane-sided polyhedra, each of which may be described as the domain of one component atom. The twelve-sided polyhedra thus derived from the cubic and the hexagonal assemblages repre-

FIG. 2.

sent the solid areas throughout which each atom exercises a predominant influence in establishing the equilibrium arrangement.

(*To be continued.*)

NOTES.

A REUTER telegram states that the New Zealand meeting of the British Association has been cancelled, and that the members will return home after visiting Brisbane and Melbourne.

WE deeply regret to have to record the death, at Torquay, on August 14, of Mr. A. J. Jukes-Browne, F.R.S.

THE death is reported, in his sixty-fourth year, of Dr. Franklin W. Hooper, director since 1889 of the Brooklyn Institute of Arts and Sciences. He had previously been professor of natural science at Adelphi College, Brooklyn. He was the organiser of the Brooklyn Museum of Arts and Sciences, the Brooklyn Children's Museum, and the Brooklyn Botanic Garden. He had also taken a prominent part in the administration of the Brooklyn Board of Education and the Brooklyn Public Library.

REV. DR. HORACE CARTER HOVEY, an American geologist who had made a special study of cave formations, has died at Newburyport, Mass., at the age of eighty-one. He contributed geological articles to the ninth, tenth, and eleventh editions of the *Encyclopædia Britannica,* and was the author of several volumes on the mammoth cave of Kentucky.

THE death is announced of Dr. R. F. Harper, professor of Assyriology in the University of Chicago since 1892. In 1906 he was appointed director of the American School of Archæology at Jerusalem. He will be chiefly known by the publication of the texts of the Assyrian letters and reports of the reigns of Sargon, Sennacherib, Esarhaddon, and Ashurbanipal, preserved in the British Museum. Thirteen volumes have been published, and Prof. Harper was finishing the fourteenth at the time of his death. This volume will be issued in due course, together with the fifteenth volume, dealing with Assyrian Palæography, which he had planned.

THE Iron and Steel Institute has been obliged to abandon the holding of its proposed autumn meeting in Paris.

IN consequence of the war, the publication of the *British Pharmacopoeia*, 1914, has been indefinitely postponed. Advance copies will not, therefore, be accessible to the public for inspection as had been arranged. Due notice will be given as soon as it is decided that the time has arrived when the work shall be published.

A CIRCULAR has been issued by the Council of the Institution of Electrical Engineers to the members of the institution, pointing out two directions in which the members may be of great service to the nation at the present time, first, by placing their services as electrical engineers at the disposal of the War Office and the Admiralty, and, secondly, by being ready to fill vacancies in public services, electric power stations, tramways, railways, etc., caused by the calling up of the Reserves and the Territorial Forces. With the view of being ready to assist the authorities and the public services, the Council has decided to prepare classified lists of suitable men, and for this purpose has asked members who are in a position to assist in the directions indicated, to fill in and return a form giving full particulars of the occupations for which they are fitted. Not only are members of the institution required, but as many other qualified men as possible. Further information may be obtained from the Secretary of the Institution of Electrical Engineers, Victoria Embankment, W.C.

WE learn from *Engineering* that a scheme has been set on foot for the founding of an Australian Institution of Engineers.

M. L. TESTUT, Professor of Anatomy in the University of Lyons, contributes to *L'Anthropologie* (vol. xxv., January–April, 1914), under the title of "Dissection d'un Imbécile," a careful study of the skull and brain of an idiot, aged 69, who died at the General Hospital in 1886. The article is well illustrated and contains a large amount of statistical information. The writer claims that he has gained important results by supplementing his examination of the brain by that of other organic systems.

THE Carnegie Institution of Washington has just published "A Reconstruction of the Nuclear Masses in the Lower Portion of the Human Brain-stem," by Mr. L. H. Weed, of the Harvard Medical School. This valuable publication embodies the results of an extremely careful and laborious piece of work in a field in which the labourers are comparatively rare. The majority of previous studies deal only with plotted limits and not with actual morphology. Mr. Weed, however, by means of the wax-plate method, has constructed an accurate and enlarged model of the nuclear masses in the medulla and pons from a series of more than 2000 serial sections—40 microns in thickness, and stained by the Weigert-Pal method—comprising one of the "loan collections" in the anatomical department of the Johns Hopkins Medical School. As this is practically a purely morphological study, the text, for the most part, is descriptive, and contains no controversial or hypothetical matter. The six coloured plates, comprising fourteen figures, show different aspects of the model and cross-sections at various levels, and reproduce the more important features and relations of the nuclear matter in the brain-stem.

IN vol. viii., Nos. 2 and 3, of the *Quarterly Journal of Experimental Physiology*, there are four articles dealing with the internal secretion of the ductless glands. The most conclusive are those of P. T. Herring, who differentiated between the extracts of the intermediate and posterior segments of the pituitary body of the ox by the effects, which these produced, on the uterus of the virgin rat, and on the blood-pressure and volume of the kidney in the cat, respectively. T. Graham Brown has contributed two further elaborate studies on the nervous system, dealing with the rhythmic movements in flexor and extensor muscles under certain conditions. He holds that similar rhythmic phenomena underlie the act of mammalian progression, walking, galloping, etc. Rhythmic contraction has been demonstrated by J. A. Gunn and S. W. F. Underhill in the circular muscle—completely freed from nerve cells—of the small intestine of the cat many hours after its removal from the body. The journal contains other articles of an interesting but highly technical character.

THE first part of the second volume of the zoological section of the Natural History Report of the British Antarctic (*Terra Nova*) Expedition, 1910, published by the trustees of the British Museum, is devoted to a list of the collecting stations, drawn up by Dr. S. F. Harmer and Mr. D. G. Lillie, the latter of whom served in the expedition. It comprises twelve 4to pages and four maps, the total number of stations being 357, commencing near the western mouth of the English Channel and extending close to lat. 80° S. The greater portion of the stations were for plankton-collecting, but the list includes a certain number of localities at which specimens were obtained by the shore-party. During the first sorting of the collection a system of numbering was adopted which has not proved suitable for more permanent use, and these provisional station-numbers, which are entered in the third column of the tables, have accordingly been replaced by others, which occupy the second column, and correspond with those in the maps. The plankton-nets used are referred to the number of meshes per linear inch, the "full-speed net" having no fewer than 180.

IN continuing his article on pattern-development among mammals and birds in the August number of the *American Naturalist,* Dr. G. M. Allen suggests that the light-coloured rump-patch so common among ungulates, and generally regarded as a "recognition-mark," is probably due to the total inactivity of the primary pigment-patches usually covering that region of the body. Among the ground-squirrels, or chipmunks, a transition may be observed from a uniformly grizzled coat to one indistinctly spotted, then to one with rows of white spots, and finally to others with broken or complete longitudinal white stripes. Such stripes the author believes to be due to the development, not of breaks between the primary pigment-patches, but of small pigmentless spots, which, in their fullest intensity, unite into stripes. On the other hand, it is quite conceivable that the reverse condition—the breaking up of stripes into spots—may likewise occur in some instances.

IN "A Fourth General Adjustment of the Precise Level Net in the United States and the Resulting Standard Elevations," by W. Bowie and H. G. Avers (pp. 328; Special Publication No. 18; Washington: Government Printing Office, 1914), the results of the latest adjustment of the level net of the United States are discussed, all precise levelling done previous to 1912 being included except those lines which do not form portions of closed circuits. On this occasion the orthometric correction has been applied to standard altitudes westward of the Mississippi River, since this correction is found to be needed in high altitudes. Altitudes are now given both in feet and metres, the former being added for the convenience of surveyors and engineers who may use the results. Instruments and method of levelling have been the same as in preceding years; the rate of work has varied from 56 to 84 miles a month, according to the character of the country traversed, and the average cost has been rather above *2l.* per mile. For the present publication, after the orthometric correction had been applied to the levelling westward of the Mississippi, an adjustment of the entire net was made, using the weights as determined by the 1907 adjustment. A special adjustment was also made of altitudes in the western part of the country with very satisfactory results. The accidental and systematic errors of the levelling, which has been carried out by the Coast and Geodetic Survey since 1899, has, in this report, been computed in accordance with the resolutions adopted at the Conference of the International Geodetic Association, held at Hamburg in 1912, and for levelled lines totalling 15,028 kilometres, the probable accidental error is given as ±0·713 mm. per kilometre, and the probable systematic error as ±0·080 mm. per kilometre. It is, however, pointed out that this systematic error cannot include all sources of error, since the probable accidental error for a kilometre, as found in the general adjustment of 1912, is considerably larger than that obtained by the International formula.

IN an interesting paper in the *Popular Science Monthly* for August Dr. William H. Ross, of the United States Bureau of Soils, deals with the origin of nitrate deposits, more particularly of the famous Chilean beds, which occur in the deserts of Atacama and Tarapaca, and still form the principal source of the world's supply of nitre. In the year 1912, for example, the total quantity exported from Chile was 2,485,860 tons. The origin of these enormous deposits is still uncertain; the various theories which have been put forward to explain their existence are dealt with in some detail in the present paper. It has been suggested that they have been formed by the nitrification of immense deposits of sea-weed, of guano, or of the dung of vicuñas and llamas, but it is more probable that they represent the concentrated fertility of the thousands of square miles of land between the watershed of the Andes and Coast Range, the nitrates formed in these regions being washed out by the periodical mountain floods, which occur every seven or eight years, and subsequently recovered by the evaporation of the leachings in the lower levels, where the nitrates are found.

AMONG palæontological papers it may be mentioned that the latest issue of the *Palaeontologia Indica* (ser. 15, vol. iv., part ii., fasc. 4) is devoted to the description, by Dr. K. Holdhaus, of the lamellibranchs and gastropods of the Silurian Shales of Spiti, N.E. Himalaya, in which a number of new species, and at least one new genus, are named. Also that the Egyptian Survey Department has issued the first part of a catalogue of the invertebrate fossils of Egypt represented in the collections of the Museum of Geology at Cairo, by M. R. Fourtau. This deals with Cretaceous echinoderms, a group in which the Cairo Museum is particularly rich, as the result of collections made of late years in the Sinaitic Peninsula between Gebel Tih and the Gulf of Suez. A considerable number of the specimens represent new species, all of which, together with many others, are figured.

THE joint annual report of the Forestry Branches for 1912–1913 (London: Wyman and Sons, Ltd.), is due to a recent arrangement by which the Board of Agriculture and the Office of Woods cooperate in the development of forestry in this country. The report gives an excellent historical summary of the management of the Crown woods and forests from the earliest times until 1912. This is followed by a brief account of each of the twenty forests and wooded estates that are now under the charge of the Commissioners of Woods. These properties, with a total wooded area of 65,766 acres, consist partly of the ancient hereditary estates of the Crown (New Forest, Dean Forest, Bere Woods, etc.), and partly of estates that have been recently acquired, as Inverliever Estate in Argyllshire, and Hafod Fawr Estate in Merionethshire. Instruction in forestry is provided at the Chopwell Woods, near Newcastle-on-Tyne, which was managed by the Lecturer in Forestry of the Armstrong College, and at the School for Working Foresters in the Forest of Dean, which was established in 1903, and passed out sixty-four certificated woodmen in the subsequent nine years. The most important chapter in the report is devoted to the timber trade of the United Kingdom. The annual home supply of timber is less than 20,000,000 cubic feet, and cannot be appreciably increased, unless extensive afforestation is carried out immediately, of the actual inception of which there is no sign in the report, no money being available as *yet* from Development Funds for such a purpose in England or Scotland. The annual import of unmanufactured timber now stands at 400,000,000 cubic feet, valued at 28,360,000*l*., to which must be added manufactured timber, 3,400,000*l*., and wood pulp, 4,400,000*l*., or a total of 36,160,000*l*. annually spent on foreign timber and wood pulp. Our consumption of timber, as shown in the decennial tables of the report, has steadily grown with the progress of our industries; and during the last decade the price of timber has considerably increased. The day is not far off when coal-mining, the extension of railway and telegraph communications, building, etc., will be checked by the high price of foreign timber, the only supply available.

DISCOVERIES connecting the pre-Cambrian fossil algal flora with the blue-green algæ of to-day are announced in a preliminary report by Dr. Charles D. Walcott, published by the Smithsonian Institution. The fossil remains of these ancient marine plants which form part of the Palæontological collections of the U.S. National Museum were collected in the Algonkian formations of the Cordilleran area of Western America, chiefly in the Big Belt Mountains of Montana. Eight genera and twelve species, new to science, are described by the author, who includes illustrations of both the ancient and modern forms for comparison. Dr. Walcott proposes to visit during the present field season the localities where these old forms of life in fossil form are found, for the purpose of continuing his investigations and to gather data for a further and more detailed report.

WE have received a copy of No. 1 of a new journal dealing with biochemistry, the *Bulletin de la Société de Chimie Biologique*, which, as its name implies, is the organ of the newly formed French Biochemical Society. One of the most striking facts of the past few years is the very great development of biochemistry as a special science; this branch of chemistry has now its own journals in England, Germany, France, and the United States, all of which are regularly publishing numerous and important papers. Considering the activity of French chemists in this particular field, the existence of a special journal in which their researches may become readily available to other workers is a welcome fact. Foreign biochemists will undoubtedly wish the newly formed society every success in its efforts.

A USEFUL paper on the climate of Lorenzo Marques (Delagoa Bay), with frequent references to the meteorological elements of South Africa, by Sr. A. de Almeida Teixeira, is published in the *South African Journal of Science* for July. The mean annual temperature, from fourteen years' observations, is 72·0°; January, 78·6°; July, 64·4°. The absolute extremes quoted are 111·9° (November) and 46·0° (July), but readings above 104° and less than 48° are exceptional. Extremes of heat are due to hot winds from N.N.W., which precede atmospheric depressions; these are immediately followed by fresh south winds with a fall at times of nearly 29° within an hour and a half. The mean annual rainfall is 26·7 in., on 77 days; the wettest month is January, with 5 in.; the driest, August, with 0·5 in. The average annual percentage of hours of sunshine is 61·3, but the instrument used is Jordan's photographic recorder, which is not directly comparable with the Campbell-Stokes burning instrument. The usual four seasons are not well marked, a better division being the warm and rainy season—October to March—and the cool and practically dry season—April to September. The author points out that the climate is more pleasant than could be expected from its geographical position, owing, among other things, to the sea breezes and the scarcity of calms, and he quotes Commander de Lacerda's view that "in winter during the period of fine weather, and with the south winds prevailing, the climate may be placed on a level with the best in the world."

THE recently published Transactions of the Cardiff Naturalists' Society for 1913 contains monthly and yearly rainfall values and other details for fifty-one stations in the Society's district. The tables are arranged according to the height above sea-level; at the highest station, Tyle Brith, Brecknockshire (2350 ft.), the annual fall was 89 in.; at Cardiff, Penylan station (204 ft.), 42·1 in.; at Cadoxton, Barry (20 ft.), 32·2 in. A comparison with the averages shows that the year was abnormally wet. Climatology is indebted to Dr. E. Walford, medical officer of health, for the preparation of this useful report from data supplied by voluntary observers.

PART 3 of Publication No. 149 of the Carnegie Institution consists of a report by Prof. Carl Barus, of Brown University, on the application of interference methods of measurement in a number of branches of physics. The first is to the measurement of the index of refraction of a double refracting crystal for the extraordinary ray in terms of that for the ordinary ray, by inserting a plate of the crystal in the path of one of the interferometer beams and observing the two sets of elliptic interference fringes produced. A second is to the accurate comparison of screws, and a third to the detection and study of the motion of a resonator, or of the disc of a telephone. Attempts to detect a change in the index of refraction of rarefied air through which an electric current is passing, and measurements of the change of refractive index of air with temperature are further applications. Finally the author deals with the measurement of the deflection of an electrometer needle by interference, and shows that such an instrument will measure a few millionths of a volt.

In connection with the development of the Langley Aerodynamical Laboratory of the Smithsonian Institution, the purpose of which, it will be remembered, is primarily to plan and conduct such theoretical and experimental investigations, tests, and reports as may serve to increase the safety and efficiency of aerial locomotion for commercial advance, national defence, and the welfare of man, a visit was paid a short time ago to various kindred institutions in Europe by Dr. A. F. Zahm, the recorder of the Langley Laboratory, accompanied by Mr. J. C. Hunsaker, of the U.S. Navy. The tour of inspection included the British, French, and German laboratories; also many of the aerodromes, aircraft factories, and aeronautical libraries, the object being the study of the latest developments in instruments, methods, and resources used and contemplated for the prosecution of scientific aeronautical investigations. The results of their observations are embodied in No. 2273 of the Smithsonian Miscellaneous Collections.

Bulletin No. 8 of the Mellon Institute of Industrial Research deals with some engineering phases of Pittsburg's smoke problem. In this district more bituminous coal is used than in any other district of like size in the world. The coal found in the neighbourhood of Pittsburg is very plentiful, cheap, and rich in volatile matter. Further, the many hills and valleys and the frequent fogs hold the smoke long after it would have been carried away in another locality having a more regular topography. The soot-fall for the twelve months ending April, 1913, at the various observation stations in Pittsburg ranges from 595 to 1950 tons per square mile. Pittsburg learned the appearance of a clean city during the brief period in which natural gas was largely employed; since 1895 the use of coal has been general again. The local authorities have made attempts since 1893 to get rid of smoke production at the pumping stations, but with little success; the Mayor reported in 1913 that one of the worst offenders against the smoke ordinance is the city of Pittsburg at the Northside light plant and the Brilliant pumping station. Of special interest is a series of photographs showing two views of each locality, one on a clear day and the other on a smoky day.

We have received from the Cambridge University Press a copy of the second edition of Dr. G. S. Graham-Smith's "Flies in Relation to Disease: Non-Bloodsucking Flies," the first edition of which work was reviewed in Nature of December 11, 1913. In the work as first issued an attempt was made to collect, tabulate, and examine critically the various facts and hypotheses relating to the life-histories, habits, and disease-carrying potentialities of non-blood-sucking flies, which had been published up to the end of 1912. In the present edition the work published during 1913 is dealt with in the same manner, and in addition an account of some recent unpublished observations made by the author has been added. The volume is published at *12s. 6d.* net.

OUR ASTRONOMICAL COLUMN.

The Perseid Meteoric Shower.—The weather has been very favourable for tracing the progress of this shower. On August 10 there were not many meteors, though a few fine ones appeared. On August 11 there was a great increase in numbers, but the moon rose soon after 9 p.m. At Bristol Mr. Denning estimated that the total number of meteors visible to one observer between 9 p.m. and 3 a.m. on the following day must have been about 150. On August 12 the rate of meteoric apparitions had declined and the number visible in the same time was estimated at 110, but there were many detached clouds over the sky. On August 13 there were clouds at Bristol and few meteors were seen, but the Perseid shower had evidently decreased in a marked degree since the previous night. On the whole the display may be regarded as having exhibited moderate numbers with a large proportion of brilliant meteors. The radiant point showed the usual displacement to the eastward as observed on successive nights.

On August 16 meteors were abundant, and there were two active showers, one of late Perseids from $56° + 59°$ and another of Lyrids from $279° + 45°$.

The observations generally have been ample this year, according to reports from many stations. Mrs. Fiammetta Wilson, at Bexley Heath, recorded the paths of no fewer than 152 meteors on the four nights from August 10–13. Two magnificent fireballs were seen by her and by Miss Grace Cook at Stowmarket on August 14, viz., a Perseid at 9.34 and a slow meteor three or four times as bright as Venus directed from a radiant in the southern sky at 9.50. The latter was also recorded by the Rev. Ivo Gregg at Walthamstow, and the following deductions have been made regarding this and a few other brilliant meteors of the recent display:—

Date	G.M.T.	Mag.	Height at first	Height at end	Path	Velocity per sec.	Radiant
	h. m.		m.	m.	m.	m.	° °
Aug. 11	11 25	> 1	72	48	38	38	47 + 61
12	10 22	Sirius	78	45	59	45	48 + 58
,,	10 $33\frac{1}{2}$	♀	80	54	48	40	48 + 57
,,	10 $52\frac{1}{2}$	> 1	82	53	31	80	280 + 44
,,	11 10	1	64	49	28	14	320 − 4
14	9 34	♀	85	54	61	61	44 + 59
14	9 50	> ♀	67	44	31	16	296 + 10

The great velocity of the Lyrid of August 12, 10 $52\frac{1}{2}$, is remarkably in contrast with the rate of motion of the last two meteors in the table.

The Spectrum of Comet 1914*b* (Zlatinsky).—Dr. Slipher publishes in the Lowell Observatory Bulletin, No. 63, a description with wave-lengths of the spectrum of Zlatinsky's comet. Three spectrograms of this comet were secured at Flagstaff on the evenings of May 25, 26, and 27, using a one-prism spectrograph employed in nebular work attached to the 24-in. refractor. Vanadium and iron were used as comparison spectra, and it was possible to expose for about one and one-third hours. The wave-lengths were reduced independently from the three negatives, and all three reductions are printed in tabular form in the paper. In order to differentiate between the spectrum of the head and nucleus of the comet a long slit was used, and he is able to divide the cometary bands into two classes—long and short. The long bands comprise the carbon bands at λ5165, 4737, and 4381, and the cyanogen bands at λ4216 and 3883, these last extending even further from the nucleus. Comparing this spectrum with those of other comets, he finds that comet 1912*a* (Gale) and comet 1911*c* (Brooks) are closely of the same spectral type as Zlatinsky's: this type he considers the more usual. Halley-Daniel (1907) is a type less common, and Morehouse (1908) a truly exceptional type.

THE SPECTRUM OF SILICON.—Those engaged in astrophysical researches will welcome the important paper communicated to the Royal Society (*R. S. Proc.*, Series A., vol. xc., p. 512, August) by Sir William Crookes on the spectrum of elementary silicon. Silicon plays an important part in the classification of stellar spectra, and the wave-lengths of lines attributed to this substance by different workers are by no means similar, and the number of lines recorded in the spectrum also vary for different observers. The discrepancies have chiefly arisen owing to the difficulty of obtaining pure silicon for laboratory purposes, but Sir William Crookes has recently been able to secure specimens of considerable purity, and so is able to record the results of his labours over eleven years on this one element in this communication. The specimens worked upon were obtained from the Carborundum Company at Niagara Falls, and gave on analysis 99·56, 99·86, and 99·98 per cent. of silicon, the impurities being titanium, iron, and aluminium. The use of these specimens has allowed the author to correct the lines given by other less pure samples, and to clear up other doubtful points. The paper gives a sketch of the procedure of treatment and the method of measurement of the lines, with, finally, a list of the lines attributed to silicon, with comparison tables of the wave-length determinations of other workers; it is to be noted that no intensities of the lines are given. The following is a list of the lines recorded:—

λ 3853·812	6346·962	2516·131
3856·193	6371·032	2519·276
3862·743		2524·110
3905·726	2124·163	2528·585
4089·016	2208·048	2541·970
4097·021	2210·987	2631·370
4128·189	2211·839	2881·690
4131·192	2216·882	2987·750
4552·841	2218·227	3086·479
4568·123	2435·212	3093·694
4574·823	2438·911	3247·684
5042·715	2443·484	3438·444
5057·832	2452·219	3796·364
5961·6	2507·055	3806·802
5982·0	2514·406	

THE TOTAL SOLAR ECLIPSE.—Attention is directed to the article in NATURE of July 16 on the eclipse of the sun which is to take place to-morrow. In the communication in question particulars are given of the various observing parties and the positions and duties assigned to them. The outbreak of hostilities must necessarily interfere with the programme therein sketched, *e.g.* the expedition which was to have been stationed near Kief has had to abandon its proposed work. According to the *Times*, Major Hills, president of the Royal Astronomical Society, has arrived in London from Russia, and Prof. Fowler and Mr. Curtis may be expected shortly. The party had considerable difficulty in getting away from Russia, having to travel from Riga to Copenhagen as deck passengers on a cargo steamer.

RECENT JAPANESE BIOLOGICAL PUBLICATIONS.[1]

THE papers here noted are reprints from the Journal of the College of Science, Imperial University of Tokyo, covering a period of five months, and do not by any means fully represent the output of the Japanese botanists and zoologists during this period, various other papers in natural history by Japanese workers having appeared in other journals—chiefly American. However, they form a fair sample of the large quantity and high quality of the biological work which is being done in Japan, and one is grateful to the authors and the publishing committee for refraining from publishing any part of this important journal—except a small part of the outer covers—in Japanese, which is, unfortunately, from the point of view of readers in other lands, still used in some other scientific journals published in Japan and usually without a summary in another language. The articles mentioned here are taken in order of numbering of the volumes to which they belong. The method of publication of the Tokyo science journal is to keep on starting fresh volumes before the preceding three or even four have been completed, instead of finishing off each volume as the various consecutive papers are published; the latter would certainly appear to be the better plan.

(1) Kinoshita gives a very detailed and beautifully illustrated description of the alcyonarian family Chrysogorgiidæ, as represented in Japanese waters, twenty species being dealt with, of which eight are new. He criticises the view put forward by Neumann and others that the stems and branches of the Gorgonid colony are mouthless vegetative polyps, and discusses in some detail the morphology of the canal system and the cœnenchyma in Alcyonaria generally.

(2) Koidzumi contributes a valuable monograph of the family Rosaceæ as represented in the Japanese Empire, with Latin diagnoses of the forty genera and nearly two hundred species now known, and interesting notes in English, with tables, showing the distribution of these plants. These tables are most useful, since they display the distribution of the subfamilies, genera, and species of Japanese Rosaceæ, not only in Japan itself, but in various parts of the world, statistics of endemic and introduced as compared with indigenous species, etc.

(3, 4) Liebwohl gives in these two papers a monographic account of the Tetraxonid sponges of Japan, illustrated by very fine plates. The material was collected by Prof. Ijima (who had already worked up the Hexactinellid sponges of Japan), and sent to Prof. von Lendenfeld, by whom the preparation of this monograph was entrusted to the author.

(5) Koketsu's paper on the latex-containing tissues of Japanese plants contains much that is of general interest, for not only is the structure of the laticiferous vessels full worked out and illustrated, but interesting micro-chemical and physiological experiments are described. After a useful summary of the various views that have been put forward regarding the functions

[1] (1) K. Kinoshita: "Studien über einige Chrysogorgiiden Japans." Journ. Coll. Sci., Imp. Univ. of Tokyo, vol. xxxiii., Art. 2 (November 30, 1913). Pp. 47+3 plates+34 text-figures.
(2) G. Koidzumi: "Conspectus Rosaceanum Japonicarum." *Ibid.*, vol. xxxiv., Art. 2 (October 28, 1913). Pp. 312+12 text-figures+8 tables.
(3) F. Liebwohl: "Japanische Tetraxonida. i. Sigmatophora; ii. *Astrophora metastrosa.*" *Ibid.*, vol. xxxv., Art. 2 (March 15, 1914). Pp. 116+9 plates.
(4) F. Liebwohl: "Japanische Tetraxonida. iii. Euastrosa; iv. Sterrastrosa." *Ibid.*, vol. xxxv, Art. 5 (March 20, 1914). Pp. 70+2 plates.
(5) R. Koketsu: "Studien über die Milchröhren und Milchzellen einiger einheimischer Pflanzen." *Ibid.*, vol. xxxv., Art. 6 (December 25, 1913). Pp. 57+3 plates+12 text-figures.
(6) K. Koriba: "Mechanisch-physiologische Studien über die Drehung der Spiranthes-Aehre." *Ibid.*, vol. xxxvi., Art. 3 (March 30. 1914). Pp. 179+7 plates+14 text-figures.

of latex, the author concludes that the latex tubes do not serve for conduction of useful organic substances, that such substances when present in latex are probably not utilised at all by the other tissues of the plant, and that the question belongs to ecology rather than to physiology, the chief functions of latex being essentially that of protection against animals, and in some cases that of closing over injuries to the plant.

(6) Koriba deals in this long and very detailed paper with the many problems raised by the curious flower-spike of the orchid genus Spiranthes, in which the inflorescence is so twisted as to bring the flowers into from one to three rows. The paper is of great general interest, since, in addition to his own exhaustive observations extending throughout the life-history of the plant from germination to flower development, the author discusses the general question of the arrangement of leaves and other lateral organs in plants, torsion and other displacements of organs, etc., with a very full bibliography of these aspects of general morphology, nowadays somewhat neglected by botanists.

F. C.

ROYAL SOCIETY OF CANADA.

THE annual meeting of the Royal Society of Canada was held this year at Montreal on May 26–28, under the presidency of Prof. Frank D. Adams, F.R.S. The general and sectional meetings were held in the new medical building, McGill University, and in the Laval University, and there was an excellent attendance of fellows and of visitors. Dr. R. F. Stupart presided over Section III. (Mathematical, Physical, and Chemical Sciences), and in the absence of the president of the section, Prof. A. P. Coleman, Prof. A. H. R. Buller presided over the proceedings of Section IV. (Geological and Biological Sciences).

In his presidential address, Prof. Adams spoke on the national domain in Canada and its proper conservation. As a member of the Canadian Commission of Conservation, Prof. Adams was well qualified to review in all its aspects the national importance of the proper conservation of the natural resources of the Dominion, and he considered, in a comprehensive manner, agriculture, forests, water-powers, mines, fisheries, and the fur trade. By means of statistics and charts he described the manner in which the supplies of iron and coal were being exhausted, how the supply of merchantable timber, which is usually overestimated, is disappearing at a rapid rate, and the reckless destruction of the natural fertility of the soil brought about by growing only a single crop and bad farming. He indicated the manner in which the conservation of these resources was dependent upon the application of scientific methods to the various forms of production and the dependence of manufactures and transportation systems upon careful conservation. Conservation does not mean hoarding up, but development without waste. "Each generation," the president said, "is entitled to the interest on the natural capital, but the principal should be handed on unimpaired."

The president of Section III. (Dr. Stupart) considered in his address the present position of meteorological science. He contended that the success achieved in storm warnings and forecasts was ample warrant for the system, largely empirical, now in vogue in all civilised countries. The general international scheme for the exploration of the upper atmosphere was outlined and a comparison was given of the results obtained in Europe, Canada, and the equatorial regions. The present ignorance of many of the factors which lead to cyclonic and anti-cyclonic disturbances in higher latitudes was pointed out, and the factors concerning which more knowledge was available were described. In opening a discussion on the structure of the atom, Drs. A. S. Eve and J. C. McLennan considered the rapid progress in blending the Thomson electron rings with the Rutherford nucleus, Moseley's experiments on the atomic number with the isotopic theory of Fajans and Soddy, Bohr's views with the Rydberg number of Planck's quanta, and the hydrogen nucleus as positive electron, according to Rutherford's recent suggestion.

Among the series of important papers presented before Section III., the following may be mentioned. Prof. H. T. Barnes, in a paper on the expansive force of ice, showed that an ice-sheet over water expands and contracts similarly to a bimetallic rod, and results in the formation of peculiar cracks. An estimate was given from available data of the expansive pressure and the tensile strength of ice. Prof. C. J. Lynde described a new method of showing that soil solutions move through the soil by osmotic pressure from points of low concentration to points of high concentration. Dr. J. S. Plaskett discussed prism material for stellar spectrographs, and showed that a marked gain in efficiency, especially towards the ultra-violet, was gained by the use of lighter flint. He also described the new 72-in. reflecting telescope which is to be erected by the Dominion Government near Victoria, B.C. Dr. F. T. Shutt read a paper on the nitrogen compounds of rain and snow. For the year ending February, 1914, the eighth of the investigation, the total nitrogen furnished by precipitation amounted to 6·207 lb. per acre, and for the total period during which the inquiry has been carried on the average per annum is 6·182 lb.

A large proportion of the papers communicated to Section IV. were of a physiological character. Prof. A. T. Cameron described the distribution of iodine in plant and animal tissues. He showed from a wide series of iodine analyses that iodine is an almost invariable constituent of all organisms, plant and animal, the amount present depending upon the diet and mediums of the organism. With greater development there is greater specificity of the tissue concerned in storing iodine, until in the vertebrates no tissue except thyroid contains appreciable quantities. Miss D. Duff described the trematode, *Amphistomum subtriquetrum*, Rudolphi, found in the cæcum and colon of the Canadian beaver. This species was described by Rudolphi as a parasite of the European beaver, a fact of interest from the point of view of geographical distribution. Mr. L. Lambe described a new species of Aspideretes from Alberta, and a new species of Platysomus, noteworthy on account of its large size. Dr. C. Gordon Hewitt communicated the results of a series of observations on the feeding habits of the stable-fly, *Stomoxys calcitrans*, in which investigation the flies had been fed chiefly on human blood. Duration of feeding lasted from two to twenty-five minutes; the time required for the digestion of the whole meal varied from $49\frac{3}{4}$ to 95 hours. Prof. A. H. R. Buller described the subterranean parts of the fruit bodies of certain Hymenomycetes, such as *Collybia radicata*, *C. fusipes*, *Mycena galericulata*, *Coprinus macrorhizus*, etc., in which the extensions of the fruit bodies below the ground occur when the mycelia are deep-seated. Development is from below upwards, and a useful purpose is served in allowing the fungus to reach the surface of the ground before the spore-pilei are developed.

Instead of the annual popular lecture, illustrated addresses on popular subjects were given by representatives of the sections. Dr. L. G. Herdt, representing Section III., dealt with "The Development of our Water Powers and their Effect on the Progress of Canada." Dr. C. Gordon Hewitt, representing Section IV., spoke on the destruction of trees by insects in Canada and modern methods of fighting them.

The following officers were elected:—President, Sir Adolphe B. Routhier; vice-president, E. F. Burton; hon. secretary, Duncan C. Scott; hon. treasurer, C. Gordon Hewitt; hon. librarian, D. B. Dowling. Three new fellows were elected on the scientific sections:—Section III., F. B. Allan and F. M. G. Johnson; Section IV., Sir Thomas G. Roddick.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—It has been decided by the Council of the Senate to allow terms and leave to postpone examinations to all undergraduates who are prevented from residing by the requirements of military service at the present time. There is no reason for supposing that the University will not reassemble as usual for the Michaelmas term.

London.—The Vice-Chancellor has written to the *Times* to say that the Senate is anxious to do all in its power to render it easy for members of the University, and especially for cadets of the Officers' Training Corps, to offer their services to the Government. To this end, in the first place, all fees paid in for examinations which a student is for the above reason unable to take will be remitted. In the second place the Senate will take each and every step possible to prevent students who are serving their country from being in any way prejudiced in their university career, and will willingly make any special arrangements that may be possible for the same purpose.

Emergency first-aid and nursing classes have been arranged to be held daily, under the direction of Sir John Collie, who will lecture on first aid. Dr. Christine Murrell will lecture on nursing. The courses began on Monday last. Particulars are obtainable from Miss Claire Gaudet, care of the University Extension Registrar, University of London, South Kensington.

Oxford.—The Vice-Chancellor has sent a letter to the daily Press with reference to the measures likely to be taken by the University in order to relieve undergraduates from any disabilities which might arise under statutes relating to them, in consequence of their absence on military service. He says:—"(1) At the time of the war in South Africa a general decree was passed allowing men who owing to their absence would have passed the time-limit for entering the honour schools to have an extension of time. I propose to introduce a similar decree when the term begins. (2) Other undergraduates were allowed to count the terms which had elapsed during their absence as if they had been in residence. These cases were provided for by a separate decree for each individual. I should propose that this procedure should be repeated. (3) The case of candidates for scholarships who may, owing to their absence, be unable before the age of nineteen to come up for examination is much more difficult, and can only be dealt with by cooperation amongst the colleges." The Vice-Chancellor further states that he sees no reason why term should not proceed as usual.

It is stated in the *Lancet* that several citizens of Toronto have agreed to contribute sums amounting to 15,000 dollars for five years in order that research work may be engaged in at the University of Toronto. It also states that Dr. D. A. Campbell, of Halifax, Nova Scotia, has promised 60,000 dollars to endow a chair of anatomy at Dalhousie University, Halifax, in memory of his son, the late Dr. George Campbell.

The prospectus for the session 1914–15 of courses and regulations for degrees in arts and science in the University of Leeds has been received. We notice that, in common with other of the more modern English universities, the degree of bachelor of science may be taken in applied as well as in pure science. In his final course the candidate for a degree may select from the following branches of applied science: mechanical, civil, electrical, mining, or gas engineering; agriculture; and applied chemistry. Applied chemistry includes two branches, namely, colour chemistry and dyeing, and the chemistry of leather manufacture. The university also awards diplomas in applied science and technology, and offers facilities to persons desiring to pursue original research in the University laboratories.

The Staffordshire County Council Education Committee has issued its directory for higher education, 1914–15, containing the regulations of the committee and details of schemes in operation throughout the county. The arrangements outlined are very complete, covering many branches of pure science and technology, and it is possible to refer to one or two departments only. Instruction in mining is provided by means of lecturers, whose whole time is devoted to the work, and their assistants. For this purpose the county is divided into two portions, comprising the North Staffordshire Coalfields and the South Staffordshire Coalfields respectively. Theoretical and practical classes in metallurgy and iron and steel manufacture are conducted in accordance with the regulations of the Board of Education and the City and Guilds of London Institute. The principal centre in South Staffordshire is Wednesbury, where it is hoped the new County Metallurgical and Engineering Institute will be opened this autumn. Lectures and laboratory classes in subjects related to engineering will be conducted at the new institute. The course will include instruction in mathematics, physics, applied mechanics, theory of heat engines, and so on, with the necessary workshop practice. Among other subjects in which instruction is to be provided in various parts of the county may be mentioned: pottery and porcelain manufacture, silk manufacture, agriculture, horticulture and hygiene, home-nursing, and first aid. The system of scholarships of which particulars are given seems well designed to ensure that every student should have the opportunity of carrying his education as far as his powers make possible.

SOCIETIES AND ACADEMIES.

London.

Geological Society, June 24.—Dr. A. Smith Woodward, president, in the chair.—V. C. **Illing**: The paradoxidian fauna of a part of the Stockingford Shales. This communication deals mainly with a small subdivision of the Stockingford Shales occurring at the base of the Oldbury division. The beds have been termed the Abbey Shales, and are about 100 ft. thick, consisting mainly of blue laminated shales, although glauconitic sandy horizons occur at frequent intervals. This small subdivision passes down into the Purley Shales, while it is separated from the overlying shales (which are probably of Lower Maentwrog age) by a calcareous conglomerate lying upon an eroded surface of the underlying blue shales, although the irregularity of the eroded surface does not appear to be great in the somewhat poor exposures. The beds have been examined in a series of trenches situated near the Abbey Mound in Hartshill Hayes, and have yielded over fifty different species of trilobites—each ranging through one or more of about fifteen fossiliferous horizons in the sequence. The fauna shows marked affinities with those of the equivalent beds in Wales, Scandinavia, and Bohemia.—T. C. **Nicholas**: The trilobite fauna of the Middle Cambrian of the St. Tudwal's peninsula (Carnarvonshire). In a previous paper on the geology of the St. Tudwal's peninsula approximate determinations were given of the fossils found in the Upper Caered Mudstones and Nant-pig Mudstones, both of Middle Cambrian age. The object of the present paper is to give detailed descriptions of several forms which are either new or of particular interest, namely, *Agnostus kjerulfi*, two new species of Agnostus, a species of Agraulos, of Dorypyge, of Corynexochus, and *Solenopleura applanata*, and to give brief notes on a number of other species, including *Agnostus punctuosus*, *A. exaratus*, *A. fissus*, *A. altus*, *A. truncatus*, *Microdiscus punctatus*, *Conocoryphe* cf. *dalmani*, and *Paradoxides hicksii*. The vertical distribution of the different forms through the Upper Caered and Nant-pig Mudstones is tabulated and compared with that of other areas, particularly the succession recently established by Mr. V. C. Illing in the Abbey Shales of Nuneaton. This comparison strengthens the opinion already put forward in the previous communication, that there is a non-sequence at the base of the Lingula Flags in the St. Tudwal's Peninsula.

PARIS.

Academy of Sciences, August 3.—M. P. Appell in the chair.—J. **Boussinesq**: Theoretical considerations on the filtration of liquids by sand or by other analogous porous media, and on the analogy between electric currents with those of filtration.—L. **Lecornu**: The aerodynamic laboratory of Auteuil. A summary of the work recently undertaken by G. Eiffel, including a three-dimension logarithmic model composed of three scales of different directions, carrying as graduations the logarithms of the weight of the apparatus, its velocity, and the power developed by the propeller.—H. **Le Chatelier**: The iron-zinc alloys. Remarks on a recent communication of M. Taboury, directing attention to earlier work on the same subject by Berthier, Le Chatelier, and Wologdine.—H. **Parenty**: The constitution of the jet of elastic fluids below various orifices.—Th. **Anghelutza** and O. **Tino**: The polar equation.—Thadée **Peczalski**: Corresponding states with respect to temperature.—R. **Fosse**, A. **Robyn**, and F. **François**: The gravimetric quantitative analysis of urea in the blood. Details of the application of the xanthhydrol method, in which the urea is weighed as the compound

$$CO.\left(NH.CH<^{C_6H_4}_{C_6H_4}>O\right)_2.$$

—E. **Gourdon**: The mineralogical constitution of Jenny Island (Antarctic). The island consists of a *massif* of gabbro, with numerous lodes of andesites and andesi-labradorites. Ten complete analyses of the minerals are given.—J. **Chaine**: Observations on the study of the phylogenic development of the soft parts and hard parts of the organism.—Eugène **Pittard**: Comparative analysis of some body magnitudes in Bulgarians of both sexes. The difference in height between the sexes is 13 cm. larger than is usual for races of medium height. The skull is relatively more developed in the women than in the men.—Pierre **Girard**: An attempt at a physical scheme for the semipermeability of living cells to ions. A study of the diffusion of solutions of barium chloride into dilute acid and alkaline solutions, and a suggested modification of the Ostwald hypothesis of the semipermeability of membranes to ions and not to molecules, with application to the mechanism of the exchanges of electrolytes between living cells and their media.—Mme. Marie **Phisalix**: Vaccination against the poison of *Heloderma suspectum* with cholesterol and with the venom itself. Guinea pigs were found to have been immunised against double the usual fatal dose of the poison either by cholesterol or by the venom itself. The venom contains at least two active substances, one possessing vaccinating properties destroyed by five minutes' heating to 80° C., the other toxic and resistant to heat.—J. **Cantacuzène**: A micro-organism isolated in scarlet fever. A description of an organism, accompanied by photographs, and of the lesions caused by its inoculation into *Macacus rhesus*.

August 10.—Georges **Lemoine**: Notice on the life work of Louis Henry.—J. **Boussinesq**: Theory of the transpiration of gases through porous media.—Edmond **Delorme**: Battle wounds: advice to surgeons in the field.—The Perpetual Secretary announced the death of M. Considère, correspondant for the section of mechanics.—MM. **Chaspoul** and **Bachalard**: The action of radium on the sensibility of crystal detectors used in wireless telegraphy. The number of sensitive points on a crystal detector used in wireless telegraphy is notably increased under the influence of the radium emanation.—J. **Blumenfeld** and G. **Urbain**: The ultra-violet spectrum of neoytterbium. A list of wave-lengths of the spectrum of the neoytterbium the preparation of which was described in a recent paper in the *Comptes rendus*.—François **Canac**: A new method of crystallographic measurements by means of the Röntgen rays. Details of measurements on a crystal of cane sugar. The advantages claimed are that the reticular structure alone is concerned, and not the crystal faces, and the ratio of the parameters is known with exactness, since the reticular planes of great density are shown without ambiguity by the intensity of the spot which they give.—M. **Herlant**: The mechanism of the first segmentation of the egg of the sea-urchin in experimental parthenogenesis by J. Loeb's method.—Albert **Frouin** and D. **Roudsky**: The bactericidal and antitoxic action of lanthanum and thorium salts on the cholera bacillus. The therapeutic action of these salts in experimental cholera. Thorium and lanthanum salts are not poisonous, and do not interfere with digestion. It would appear from the experiments cited that thorium sulphate may be usefully employed in the treatment of cholera.—M. and Mme. Victor **Henri**: Study of the metabiotic action of the ultra-violet rays. Theory of the production of new microbial forms by the action on the different nutritive functions. Under the influence of a short irradiation, the anthrax bacillus would appear to lose the power of secreting proteolytic ferments, whilst retaining the power of producing amylolytic ferments.

CALCUTTA.

Asiatic Society of Bengal, July 1.—Ramesh Chandra **Majumdar**: The date of Chashtana. The date of Chashtana, the founder of the long line of Saka kings, has hitherto been held to be about 130 A.D. It is shown that such a theory is untenable in the light of modern researches, and that Chashtana most likely flourished at the end of the first century A.D.—Nilmani **Chakravarti**: Spirit belief in the Jātaka stories. The belief had its origin in the soul theory, according to which even a tree had a soul. There were two kinds of spirits, good and evil. The former class was subdivided into three classes, viz. I. Spirits dwelling in towns, houses, etc. II. Spirits dwelling in trees.

III. Spirits of rivers, the sea, etc. Of these, spirits dwelling in trees formed an important class. All men, even kings, used to have trees for worship. Sacrifices of goats, lambs, pigs, and cocks used to be offered before the tree gods and human sacrifices were not unknown.—H. **Beveridge**: The date of the death of Shah Beg Arghūn, the ruler of Sind.—H. **Beveridge**: Sirhind or Sahrind.—Maulavi M. Hidayet **Hosain**: Note on a history of Fīrūz Shāh, called Sīrat-i-Fīrūz Shāhī.—Sahityacharya Pt. Bishweshwar Nath **Shastri**: Jhalrapatan stone inscription of Udayaditya [vikram] Samvat 1143 (1086 A.D.) This is a stone inscription in Sanskrit dated 1086 A.D., and recovered from Jhalrapatan in Rajputana. It records that a certain person named Janna built a temple of Siva and dug a tank, in the reign of the Udayaditya who is said to be a successor of Pramāra Bhoja.

BOOKS RECEIVED.

Ministry of Finance, Egypt. Survey Department Geological Survey of Egypt. Palæontological Series, No. 2: Catalogue des Invertébrés Fossiles de l'Egypte représentés dans les Collections du Musée de Geologie au Caire. Terrains Crétacés. 1re Partie: Echinodermes. By R. Fourtau. Pp. vii+109+plate viii. (Cairo: Government Press.) 40 P.T.

Memoirs of the Boston Society of Natural History. Vol vii., No. 1: Monographs of the Natural History of New England. The Fishes of New England. The Salmon Family. Part i. The Trout or Charrs. By W. C. Kendall. Pp. 103+vii plates. (Boston: Boston Society of Natural History.)

The Gaseous Metabolism of Infants. By F. G. Benedict and F. B. Talbot. Pp. 168. (Washington: Carnegie Institution.)

Department of Marine Biology of Carnegie Institution of Washington: Papers from the Tortugas Laboratory of the Carnegie Institution of Washington. Vol. vi. Pp. 322+x plates. (Washington: Carnegie Institution.)

The Osmotic Pressure of Aqueous Solutions. Report on Investigations made in the Chemical Laboratory of the Johns Hopkins University during the Years 1899–1913. By Prof. H. N. Morse. (Washington: Carnegie Institution.)

The Production of Elliptic Interferences in Relation to Interferometry. Part iii. By Prof. C. Barus. Pp. vi+169–273. (Washington: Carnegie Institution.)

The Salton Sea. By D. T. MacDougal. Pp. x+182+xxxii plates. (Washington: Carnegie Institution.)

British Rainfall, 1913. Pp. 92+384. (London: E. Stanford, Ltd.)

Anthropological Report on Ibo-speaking Peoples of Nigeria. By N. W. Thomas. Part iv., pp. vi+208; Part v., pp. x+184; Part vi., pp. viii+114. (London: Harrison and Sons.) Each 4s. net.

Dairy Chemistry. By H. D. Richmond. Second edition. Pp. xi+434. (London: C. Griffin and Co., Ltd.) 15s. net.

Memoirs of the Geological Survey of India. Palæontologia Indica. Vol. iv. Memoir No. 3: Lower Gondwana Plants from the Golarbarh Pass, Kashmir. By Prof. A. C. Seward. Pp. 10+iii plates. New Series. Vol. iv. Memoir No. 4: Mesozoic Plants from Afghanistan and Afghan-Turkistan. By Prof. A. C. Seward. Pp. 57+vii plates. New Series. Vol. iv. Memoir No. 2: The Vertebrate Fauna of the Gaj Series in the Bugti Hills and the Punjab. By Dr. G. E. Pilgrim. Pp. 83+xxx plates. Series xv. Vol. iv. Part ii. Fasc. No. 4: Fauna of the Spiti Shales. By Dr. K. Holdhaus. Pp. 397+456+xciv–c plates. (Calcutta: Geological Survey.) 1s. 4d., 2s. 4d., 10s. 8d., 2s. 4d. respectively.

Solar Physics Committee. Areas of Calcium Flocculi on Spectroheliograms, 1906–1908. Measured and Reduced at the Solar Physics Observatory, South Kensington. Pp. 7. I. Comparison of the Spectra of Rigelian, Crucian, and Alnitamian Stars. II. A Discussion of the Line Spectrum of α Orionis. III. The Spectrum of γ Cassiopeiæ. By F. E. Baxandall. Pp. 41. On Some of the Phenomena of New Stars. Pp. 63+iv plates. (London: Wyman and Sons, Ltd.) 9d., 3s. 6d., and 5s. respectively.

Western Australia. Department of Lands and Surveys Geodetic Tables. (Perth, W.A.: F. W. Simpson.)

British Museum (Natural History). British Antarctic *Terra Nova* Expedition, 1910. Natural History Report. Zoology. Vol. ii., No. 1: List of Collecting Stations. By Dr. S. F. Harmer and D. G. Lillie. Pp. 1–12+4 maps. (London: British Museum (Natural History); Longmans and Co.) 1s. 6d.

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THURSDAY, AUGUST 27, 1914.

THE NEWER EDUCATION.

(1) *Dr. Montessori's Own Handbook.* By Dr. M. Montessori. Pp. viii + 136. (London: Heinemann, 1914.) Price 3*s.* 6*d.* net.

(2) *The Montessori Method and the American School.* By Prof. F. E. Ward. Pp. xvi + 243. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* 6*d.* net.

(3) *A Path to Freedom in the School.* By N. MacMunn. Pp. 162. (London: G. Bell and Sons, 1914.) Price 2*s.* net.

(1) A BOOK by Dr. Montessori is an event in the educational world; it creates an interest beyond that due to its intrinsic merit. The "Handbook" is a distinct advance on the "Method" in that the descriptions of how to use the apparatus are now given in orderly sequence and in much more detail; that the name "directress" is now replaced by "teacher," and that, instead of the "passivity," which was quite overemphasised in the "Method," we read in the "Handbook" of what the teacher has to do as well as to refrain from doing; and the importance of *teaching* the right way to do actions is fully recognised. There is, too, less of that tendency to decry current knowledge and practice which has undoubtedly done much to hinder appreciation of her own valuable work.

Like the "Method," the "Handbook" is disappointing in that it says nothing of the difficulties the teacher meets when the children do not behave in the expected way, nor are the principles by which the teacher must be guided dealt with. The book is in truth a *Hand*book, with the limitations of the "Handbook" or "Manual," as contrasted with a *brain*-book intended for those who work by intelligent application of principles rather than by rules. The reader, too, should be cautious in accepting the few physiological or psychological statements it contains. For example, a sharp distinction is drawn between sensory and motor training, though each involves the other; again, the psychology of the first paragraph of p. 122 will not withstand examination. But to those who have already grasped the principles on which their teaching should be founded, the "Handbook" will be of very real assistance. It gives, as might be expected, the best account yet published of how to use the apparatus. Dr. Montessori's deep sympathy with the child, her patience with its halting efforts, are beautifully visible throughout its pages. Patience, indeed, is not the right word, since it may suggest controlled impatience, and of impatience there is no trace; no matter how disappointingly slow the child's progress may seem to be, one cannot imagine Dr. Montessori doing otherwise than watching nature's progress with expectant and deeply interested hopefulness.

(2) Prof. Ward's book is for the most part a laborious, detailed, uncritical *résumé* of Dr. Montessori's views as given in "The Montessori Method." There are so many summaries, arranged numerically, and under (*a*), (*b*), (*c*), and so on, that the work is not stimulating—it does for the reader what he should do for himself. The best chapters are those not so directly dealing with Montessori practice.

(3) Of books criticising the meagre results of our secondary education there have been many, but none comparable in interest and importance with that of Mr. McMunn. Lively and vigorous in its English, sometimes putting conclusions more strongly than sober critics, even friendly ones may approve, it is, above all, valuable for its constructive side, and is the outcome of definite and successful experience. Inspired by Dr. Montessori's work, he endeavoured to found his class-teaching of older students on the concept of freedom, and the method of "partnership" was the outcome.

Nothing in education is wholly new, except perhaps the relative importance attached to the different means employed. Thus, in university classes in mathematics the writer, following the Jesuits, has for years put those students who understand to explain to those who do not—a plan excellent for both. Mr. McMunn improves much on this: in teaching French he arranges that the boys teach *each other,* irrespective of supposed ability; something like it has been done in teaching history, where by the aid of a school library each, even the most backward, is enabled to bring a contribution to the lesson.

Mr. McMunn has so worked out and applied his ideas that mutual self-education by the boys is carried to a much greater extent than in any other school, so far as the writer knows, and with extraordinary success—new intellectual life and interest have been generated in the boys, *especially in those who before were deemed stupid or backward.* If other teachers can use the method as he has used it, and apply it to other subjects, secondary education will take an immense stride forward.

In regard to little children, from Dr. Montessori in Rome; in regard to schoolboys, from Mr.

McMunn at Stratford-on-Avon; in regard to criminal or semi-criminal children of the streets, from Mr. Lane at the Little Commonwealth in Dorset, we learn of the wonders wrought by a wise respect for the individual personality of the pupil. Shall we learn the lesson they teach? Or shall we go on blindly in the ways of the past?

E. P. C.

THE "CONWAY" MANUAL.

The "Conway" Manual: being a complete Summary of all Problems in Navigation and Nautical Astronomy. By J. Morgan, T. P. Marchant, and A. L. Wood. Pp. 79. (London: J. D. Potter, 1914.) Price 5s.

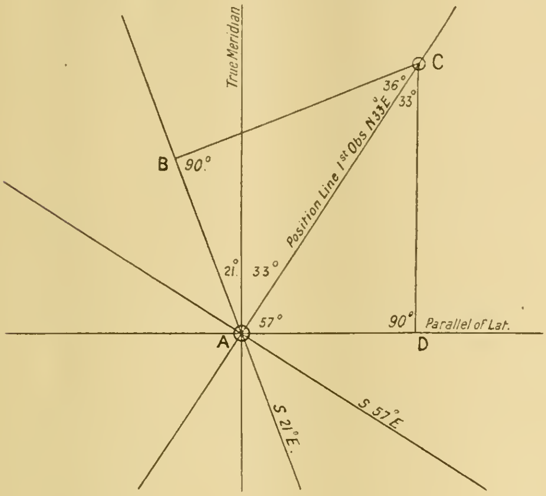
THIS manual of navigation, as taught on board the *Conway,* gives the courses of instruction the cadets of that vessel go through to prepare them to qualify as navigators afloat.

Quite properly the manual lays stress on the importance of all students being familiar with both plane and spherical trigonometry, as navigation is simply applied trigonometry, and entirely discards all rule of thumb methods, but in teaching the cadets the method appears to be to plunge at once into a statement of the formulas used—the sine formula, etc., without indicating what is meant by sines, cosines, tangents, etc. Surely in teaching beginners it is best to make plain what is meant by the expressions used.

In applying the formulas to practical navigation the manual adopts the method of zenith distances given by Marcq St. Hilaire about 1880, to the exclusion of all other methods. Now the method of position lines has been in use for nearly a century. When first started, the line of position was obtained by finding the longitude from the observation of the sun worked out with two latitudes some miles apart; the resulting longitudes gave a line on which the observer must be situated. When it became of importance to ascertain the compass errors, at the time of observation, the system of working with two latitudes was abandoned in favour of calculating the true bearings of the heavenly object, together with the longitude; as the observer must be on a line of position at right angles to the bearings of the heavenly object observed. If two heavenly objects were observed, in convenient positions with respect to each other, it is evident that the observer must be where those lines intersect, but even with one object only, by knowing the true zenith and polar distances, and the approximate co-latitude, the line of position on which the observer is situated can be placed on the chart at once, and frequently by steering along that line an accurate landfall be made. In this problem the only doubtful point is the co-latitude. By Marcq St. Hilaire's method an approximate hour angle is assumed, as well as an approximate co-latitude, and the true polar distance, to calculate an approximate zenith distance and true bearing, and the difference between the true zenith distance, as observed, and the approximate zenith distance, as calculated, plotted along the line of bearing of the heavenly object, and the lines of position parallel to each other plotted.

Lines of position are fully explained in Riddle's "Navigation," eighth edition, published in 1864, and can be obtained by the Marcq St. Hilaire method as well as by Sumners, or by calculating the longitude and azimuth of the heavenly body observed. When the sun is the heavenly object observed the zenith distance plan has the disadvantage of not giving the longitude and line of position. Witn two stars at or near right angles to each other this does not apply, but even then the method of calculating the longitude and line of bearing appears quite as advantageous as the zenith distance method. But what appears to be omitted from the "Conway Manual" in the practical work is all instruction relative to Dr. Ivory's method of double altitudes or to lunar distances, though in the case of the sun's double altitude given at page 74 the ship's position can be calculated at once by Dr. Ivory's method as expanded in Riddle's "Navigation," without trouble and without any plotting and position lines. Also, in the example of star double altitude at page 76, although the rate of the chronometer for a period of eighty-five days has to be applied to obtain the Greenwich mean time, nowhere is the student warned that in such a lapse of time the chronometer may, and probably would, have altered its rate, and that the most convenient way of ascertaining this in a ship at sea is by lunar observations.

It may perhaps be as well to point out also that in the problem on page 74, although the altitude at the first observation is corrected for the run of the ship, the latitude it is worked with is the approximate latitude of the ship at the first observation for both sets of the sun's altitude, at 11 a.m. as well as at 9 a.m. It will be found that if the hour angle and sun's bearing be obtained from the observations at 9 a.m., and the run of the ship be applied to that hour angle, as well as the elapsed time, a more correct hour angle will be obtained for the 11 a.m. observation, and the correct position got, as in the annexed diagram; where if A be the position of the ship at the time of the second observation, as obtained by applying the run from the first observation, then AC will be the position line by the first observation, AB the line of bearing of the sun at the second observation, and the distance from A to B the difference of 36 miles, the difference of the zenith distance as calculated, using the corrected



latitude and hour angle, and, as observed, then BC will be the line of position at the second observation cutting the first position line at C. Drop a perpendicular CD on to the parallel of latitude, and the distance CD, and departure AD, are easily obtained by the traverse tables without any need of drawing the diagram to scale.

THE FOSSIL INVERTEBRATES.

Text-book of Palaeontology. Edited by Prof. C. R. Eastman. Adapted from the German of Prof. Karl A. von Zittel. Second Edition, revised and enlarged. Volume I. Pp. xi+839. (London: Macmillan and Co., Ltd., 1913.) Price 25*s*. net.

THE appearance of a new edition of Zittel's "Palæontology" is always something of an event in the palæontological world, more so, perhaps, than the publication of many a weighty monograph. For this is a work which appeals not only to the student, but to each expert in his own specialty. Some years ago one could say, "there are many text-books, but only one Zittel"; but this is a tribute that can no longer be paid, since there are now two Zittels. One, the German edition, recently revised by Prof. Broili, but still evincing the cautious conservatism of the original distinguished author; the other, the American edition, retaining the preface and the illustrations of the "Grundzüge," but in almost all other respects a very different work. It is the first volume of the second edition of this latter that is now before us.

As in the previous edition, Prof. Eastman has managed to secure the cooperation of a number of well-known authorities, most of whose names (not always correctly given) appear in this connection for the first time. With the exception of Dr. W. T. Calman and Dr. A. Handlirsch, all are citizens of the United States, and have therefore not been afraid to introduce drastic alterations. In this respect, however, there is considerable difference of treatment. While, for instance, the classification and account of the foraminifera have been entirely re-modelled by Dr. Cushman, the sections on radiolaria and sponges are almost unaltered, the latter still retaining on p. 71 the misprint *Ventriculites* for *Verticillites*. Perhaps the editor was in this matter well advised, but Dr. Wayland Vaughan might have done more with the corals; he has made a few slight changes and introduced Duerden's views of the septal development in hexacoralla, but he does not, except by a literature reference, direct attention to the important studies that have lately been made on our Carboniferous corals, and the student who turns up here the much-debated Archæocyathus will be disappointed.

In the hands of Dr. Ruedemann the graptolites are safe; but we look for something more than safety, at the least for some evolutionary scheme that shall enable the student to carry the leading facts in his head, and in this case the scheme would probably have the additional merit of truth. How different is Prof. Schuchert's chapter on the brachiopoda (based on his previous valuable synopsis, but incorporating "the brilliant results of C. D. Walcott" and "the important work of S. S. Buckman")! Here is evolution with a vengeance: the Orthidæ are defined as "progressive, divergent, and terminal Orthacea, derived out of the Eoorthinæ, etc." True, the student will have to find out elsewhere than in this volume what is the precise meaning of these evolutionary terms; but the search will do him a world of good.

If only a page can be spared for fossil jellyfish, the doubtful forms should give place to those now well known, and the figure should be of a better specimen. Under "Vermes" some of Walcott's Cambrian genera are illustrated, and there is a fresh note on alleged worm-tracks, but we meet with no great change until we reach the echinoderms. In revising this phylum four experts lent their aid, and the fact that Dr. A. H. Clark was one explains the suggestion "that the echinoderms are derived from acraniate crustacean ancestors, through the cirripedia." After this it is tame to find the classification of both cystoidea and blastoidea following that of Bather. For the crinoidea, however, Dr. Springer naturally takes, with some modification, the main divisions established by Wachsmuth and Springer. The post-palæozoic genera are separated as an order, articulata, which seems rather a backward step; but it is interesting to have them arranged according to the views of Dr. A. H. Clark, even though much space is given to purely recent forms. Dr. H. L. Clark, who revises the asterozoa, seems timorous by contrast. Dr. R. T. Jackson (whose help throughout the editor acknowledges) has fortunately been able to deal with the echinoidea on the lines of his recent great monograph; our only regret is that the name centrechinoida (*vice* diademoida) has thus entered on its text-book career.

In the bryozoa, and in mollusca other than ammonoidea, we detect no great change; that important order has been entrusted to Prof J. Perrin Smith, who strikes a happy mean between the phylogenists and the geologists. With such revisers as Drs. C. D. Walcott, J. M. Clarke, P. E. Raymond, A. Petrunkevitch, W. T. Calman, and A. Handlirsch, the chapter on the arthropoda proves sound and up-to-date. The editor must have felt very happy when he had seen its last page through the press, and could turn to compile the index of more than 5500 names. We offer our congratulations and thanks.

MATHEMATICAL TEXT-BOOKS.

(1) *Le Hasard.* By Prof. E. Borel. Pp. iv+312. (Paris: F. Alcan, 1914.) Price 3.50 francs.

(2) *Intermediate Mechanics for Indian Students.* By F. C. Turner and Prof. J. M. Bose. Pp. xii+332. (London: Longmans, Green and Co., 1914.) Price 4s. 6d.

(3) *A Junior Trigonometry.* By W. G. Borchardt and the Rev. A. D. Perrott. Pp. xv+220+xvii+xx. (London: G. Bell and Sons, Ltd., 1914.) Price 3*s*. 6*d*.

(4) *Mathematical Papers. For Admission into the Royal Military Academy and the Royal Military College. For the years* 1905–13. Edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1914.) Price 6*s*.

(5) *Bell's Outdoor and Indoor Experimental Arithmetics.* By H. H. Goodacre, and E. F. Holmes, C. F. Noble, P. Steer. Teacher's Book. Pp. xii+377. (London: G. Bell and Sons, Ltd., 1914.) Price 3*s*. 6*d*. net.

(6) *The Theory of Proportion.* By Prof. M. J. M. Hill. Pp. xx+108. (London: Constable and Co., Ltd., 1914.) Price 8*s*. 6*d*. net.

(7) *Dynamics.* By Prof. H. Lamb. Pp. xi+344. (Cambridge: University Press, 1914.) Price 10*s*. 6*d*. net.

(8) *Lectures on the Icosahedron and the Solution of Equations of the Fifth Degree.* By Prof. F. Klein. Translated by Dr. G. G. Morrice. Second and revised edition. Pp. xvi+289. (London: Kegan Paul, Trench, Trubner and Co., Ltd., n.d.) Price 10*s*. 6*d*. net.

(9) *Tables for Facilitating the Use of Harmonic Analysis.* As arranged by Prof. H. H. Turner. Pp. 46. (London: Oxford University Press, 1913.) Price 1*s*. net.

(1) IT has been said that "Chance is the measure of our ignorance," and if by this it is meant that any event, the causes of which we do not understand, is to be ascribed to chance, then chance is indeed a powerful factor in life; and many of our actions and policies are determined by our estimate of it. The mathematical theory is, of course, beyond the powers of the ordinary reader; no one, for instance, who had not received a special mathematical training could make much of the excellent article on "Probability" in the "Encyclopædia Britannica." But there are general considerations and conclusions which lie apart from technical difficulties, and it is these that form the substance of this volume.

The book is divided into three parts. The first considers the meaning of probability with illustrations from the tossing of a coin, cases of limited and unlimited alternatives and inverse probability; examples are taken in which different methods appear to yield different solutions of the same problem, thus paving the way to an instructive discussion on possible elements of ambiguity in the data. The second part deals with the applications of the laws of chance to sociology, biology, physics, astronomy, and chemistry; and the third with their practical and philosophical bearing on human affairs. All these topics should appeal to the general reader.

(2) This text-book is compiled with special reference to the needs of Indian students, and includes all that is required by the syllabus of Calcutta University. There is nothing particularly original in the treatment; and although the importance of practical work is emphasised in the preface, yet in the text itself there is not as much as will be found in most recent English books. For examination purposes it will, however, be found distinctly useful, since the bookwork is set out clearly and there are a good selection of illustrative examples, worked out in careful detail. There is an unfortunate mistake in the section on circular motion, where it is stated that this implies the action of some force

acting *outwards* along the normal. We are glad to see that statics and dynamics are taken together, instead of, as often happens, being made to form distinct parts of the course.

(3) Most of the subject-matter of this book is included in the "Numerical Trigonometry" by the same authors, already noticed in these columns. There are additional chapters on solid geometry, multiple angles, and identities.

(4) Following their usual custom, Macmillan and Co. publish in a single volume the collected mathematical papers for admission to Sandhurst and Woolwich for the years 1905–1913. All the diagrams are reprinted as set, and a complete list of answers is appended. The volumes of this series are invaluable for army class work.

(5) The authors of this practical text-book have interpreted in an admirable manner the suggestions made in the Board of Education's Circular, Number 807. The course is planned to cover five years, and deals with length, area, volume, weight, and time. In addition to setting out in detail the experiments to be made, there is a number of useful notes for the teacher, enumerating such points as are likely to require special attention, detailing the requisite apparatus, and suggesting methods for organising the work of the class. Complete lists are also given at the end of the equipment that is (1) necessary and (2) desirable, together with useful information as to cost. The book is undoubtedly the work of capable and enthusiastic teachers, and the variety of the exercises is evidence of the thought that has been expended in the selection of material.

(6) The purpose of this book is to provide an account of the theory of proportion, suitable for elementary teaching. The main part of it is founded on an annual course of lectures given by the author in the University of London; but the concluding chapters are intended only for teachers or honour-students.

One of the chief points of difference between the theoretical development adopted by Prof. Hill and that of Euclid is the establishing of properties of equalities of ratios by the use of Def. 5, Bk. v., instead of introducing Def. 7, Bk. v., which gives the test for distinguishing between unequal ratios. The author is of opinion that this greatly simplifies the difficulties students meet with. For the first nine chapters, which form the elementary course, little mathematical ability is required; and a clear idea should be obtained of the meaning and nature of irrationals. Part II. deals with geometrical applications of Stolz's theorem on the test for equal ratios and further consideration of irrationals; and Part III. is historical, being a commentary on Euclid's work.

(7) This is the second volume of a treatise on mechanics, the first part of which deals with statics and has already been noticed in these columns. Together they form an excellent course of reading for scholarship divisions in secondary schools. In style, this volume closely resembles the first; the bookwork is cast in an interesting and refreshing form; the able student will find much that is highly stimulating, and the boy of ordinary capacity will appreciate the concentration on the fundamental processes required for the systematic solution of problems. Many boys are so easily bewildered by detail, that it is highly important to make them realise at the earliest moment how few and simple are the general principles of mechanics; and for this reason it is desirable to provide them with examples which require small analytical skill. In this respect, as in his volume on statics, Prof. Lamb has provided exactly what is most needed. A certain number of the traditional problems are naturally included, but the main body have been selected to illustrate principles and clarify ideas. There is an interesting appendix on the relation of abstract dynamical principles to human experience.

(8) More than twenty-five years have passed since Prof. Klein's classic treatise was first translated into English, and the nature of its contents and the line of argument are so well known as to render any account at the present time superfluous. In preparing this revised edition, Dr. Morrice has been fortunate in securing the assistance of Prof. Burnside.

(9) If a set of n values of a slightly varying quantity are taken, the expression representing them most closely is obtained from a Fourier series. To assist numerical computation, these tables, arranged by Prof. Turner, give the values of terms of the type $a_{r+1} \sin r\theta$, $a_{r+1} \cos r\theta$ to two significant figures, for values of n between 8 and 22, where $\theta = 2\pi/n$.

OUR BOOKSHELF.

India-rubber Laboratory Practice. By Dr. W. A. Caspari. Pp. viii+196. (London: Macmillan and Co., Ltd., 1914.) Price 5*s*. net.

IT must be a great temptation to any chemist who writes about rubber at the present time to devote a considerable amount of attention to the views that are in the air on the constitution of this interesting substance, or substances, and to the bearing of recent developments in colloidal chemistry on the problems presented by the preparation and properties of rubber. Dr. Caspari has expressly omitted all reference to these subjects, and has limited himself entirely to the analytical problems which arise in the ordinary routine practice of an industrial rubber laboratory, viz., the sampling and analysis of raw rubbers, the nature and properties of the various substances—rubber substitutes, fillers, pigments, etc.—used in preparing manufactured rubber, and finally the analysis of manufactured rubbers.

The methods described and recommended are well chosen, and, indeed, are those which the author has found satisfactory in actual practice. The book is, in fact, so good that one regrets the decision not to include any account of the mechanical testing of manufactured rubber. The reason given for this decision is that this method of examination is as yet merely beginning to give rise to systematic laboratory practice. Both manufacturers and planters are now, however, taking up this subject seriously, and in view of this, a statement of the experience of so careful and conscientious an observer as Dr. Caspari would have been welcomed by all interested in this subject. It is to be hoped that when a new edition of this little book is called for, the author will still further increase its utility to the rubber chemist by adding a section on mechanical testing.

The book is very well produced and illustrated, and is remarkably free from misprints.

Ancient India, from the Earliest Times to the First Century A.D. By Prof. E. J. Rapson. Pp. viii + 199. (Cambridge University Press, 1914.) Price 3*s*. net.

IT is not an easy task to write a popular introduction to the history of ancient India. A race, destitute of the historical sense, has left few records of early events save poems and dreary treatises on belief and ritual, coloured by religious antipathy and prejudices. The age of scientific excavation has scarcely begun, but even now the fresh material daily accumulating—epigraphical, numismatic, artistic—is so abundant and perplexing that the time for its scientific discussion has scarcely yet arrived. The ruling tendency of Indian history has always been centrifugal, and it is only at rare periods—those of Asoka and Harsha—that the story attains ephemeral unity, and, as a whole, it remains a record of the fortunes of petty States, without much material for a continuous sketch of social life or an account of the individual actors in the drama.

For those who desire an elaborate account of the facts, Mr. V. A. Smith's "Early History," now in its third edition, is available. Prof. Rapson is a master of the subject, and he has relieved the tedium of the narrative by some interesting disquisitions, such as a discussion of the rise of the study of Sanskrit, and of the processes by which some attempt at a chronology has been reached. The engravings of coins, architecture, and inscriptions are much to the purpose. He might have done more to illustrate the social side of the history, but so far as it goes the book forms an admirable introduction to work a knowledge of which has too long been confined to the specialist.

LETTERS TO THE EDITOR.

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

The First Description of a Kangaroo.

ON reading Dr. Estreicher's letter under this heading in NATURE of March 19 (p. 60) I wrote to Mr. Petherick, who was kind enough to send me one of his articles on the subject reprinted from the *British Australasian* for May 6, 1897. This article gives the complete passage from Peter Martyr, part of which Dr. Estreicher quoted, evidently from memory.

The passage is as follows:—"Among these trees is found that monstrous beast with a snout like a fox, a tail like a marmoset, ears like a bat, hands like a man, and feet like an ape, bearing her whelps about with her in an outward belly, much like unto a great bag or purse. The dead carcase of this beast you saw with me, and turned it over and over with your own hands, marvelling at that new belly and wonderful provision of nature. They say it is known by experience that she never letteth her whelps go out of that purse except it be either to play or suck until such time that they be able to get their living by themselves."

There can be no doubt that this is the description of a marsupial, and to me it seems very clear that it refers to an opossum. "Hands like a man and feet like an ape" implies that all four feet were used for grasping, and I cannot understand how anyone could think such a description applicable to a kangaroo, especially when we are told that the creature had a "tail like a marmoset."

The following points in the description seem to me to point to the true American opossum rather than the Australian phalanger. "Bearing her whelps about with her" implies that the animal had a litter of young. The phalangers (and kangaroos) only give birth to a single young one at a time, though sometimes a second is born before the first leaves the pouch. "They say it is known by experience" implies that the animal lived in a country either inhabited by white men or in which white men had intercourse with the natives. Neither of these conditions can have applied to Australia in the fifteenth century.

W. B. ALEXANDER.

Western Australian Museum, Perth, W.A., July 11.

The "Green Ray" at Sunset.

YESTERDAY, Sunday, August 16, I was watching the sunset over the sea. I was using binoculars, and remarked that I had never seen the horizon so sharp. The waves could be seen on the edge of the sky.

I was watching with interest the rapid disappearance of the upper rim of the sun when quite unexpectedly the golden edge turned apple-green and seemed to lag for a second or two and then vanished. The green line seemed to be broken into three, possibly by waves acting in the same way as a small irregularity on one edge of a spectroscopic slit acts on a spectrum. The waves were not big enough to be simple obstructions.

R. C. T. EVANS.

Sandringham House, Marina Crescent,
Herne Bay, August 17.

[IT is a pity that this well-known phenomenon due to atmospheric dispersion is not more frequently looked for.—ED. NATURE.]

TREATMENT OF THE WOUNDED.

At the meeting of the Academy of Sciences, held in Paris on Monday, August 10, a paper, of particular interest at the present time, was read by Inspector-General Edmond Delorme dealing with the treatment of the wounded in modern warfare.[1] General Delorme became a surgeon in the French Army during the last Franco-Prussian War, and has devoted his life to the advancement of military surgery, his text-book on that subject being recognised everywhere as a standard work. His opinion of the wounds inflicted by modern weapons is by no means pessimistic:—

"The military surgeons, at the present time," he writes, "must adopt the most conservative methods of treatment in the great majority of military wounds; indeed, such methods must be applied in practically every case of bullet wound. The opening of a modern bullet wound is so small that if the surgeon adopts strict antiseptic or aseptic dressings and refrains from probing the wound or making a systematic search for foreign bodies arrested in its track, it is possible to give the most favourable prognosis for wounds of this class. Thanks to aseptic and antiseptic methods of treatment, the wounded run less risk than in former times."

The pointed bullet, employed by the German Army, leaves very narrow wounds of entrance and exit when it penetrates the more fleshy parts of the body, but its track in the tissues themselves is marked by a considerable degree of destruction. Still, such cases, in General Delorme's opinion, should recover in the course of several days or perhaps weeks. On the other hand, wounds from shrapnel, or from deformed bullets, are often extensive, open, and complicated by the intrusion of clothing or other foreign bodies. Such wounds are not necessarily dangerous, but they frequently suppurate and require close attention when the wounded are being transported to the hospital at the base.

One naturally pays the closest attention to what General Delorme has to say regarding wounds of the abdomen—so fatal in former wars. During the last twenty years surgeons have so improved their technique that they now perform abdominal operations as safely as those on the limbs.

"The treatment of wounds of the abdomen," writes General Delorme, "deserves the closest attention of surgeons, particularly of those working at the front. We have new methods at our disposal which may ameliorate the results of a class of cases always regarded as of grave import. The advisability of operating on such cases in civil practice is open to discussion, but the case in war is quite different. In war the surgeons must lay aside any idea of opening the abdomen. The experience of all recent wars is against such means—experience in the Transvaal, Manchuria, the Balkans. In the Transvaal, even when abdominal operations were carried out by the most eminent surgeons, under the best conditions, it was found that those who were operated on yielded a smaller percentage of recoveries than the cases which were not subjected to operation."

[1] "Blessures de Guerre, Conseils aux Chirurgiens." Par M. Edmond Delorme. *Comptes rendus*, August 10, p. 394.

The modern German bullet, in full flight, leaves a very small wound on the wall of the abdomen, and seldom infects the wound by carrying clothing in front of it. The perforations produced by such bullets in the loops of intestine are minute and tend to close spontaneously. In some cases the bullet may pass between loops, leaving the intestinal wall intact.

The natural and salutary inclination on the part of the wounded to relieve both bladder and bowels, allowing the patient rest for some time, instead of hurrying him to the transport, allows a natural exudate to form round the wounded parts and favours the process of healing. For wounds of this kind the ancient methods of treatment seem best: absolute repose, refraining from prolonged transport, total abstinence from food and drink for several days, rinsing of the mouth, hypodermic injections of artificial serum, the administration of opium, and placing the patient in a half-sitting (Fowler's) posture.

It will be thus seen that the leading military surgeon of France advises conservative methods of treatment. We do not doubt that he is right. During an extensive action the surgeons at the front are suddenly overwhelmed by thousands of patients. It would be impossible to undertake, even were it advisable, prolonged and tedious operations—to give attention to one case and neglect the remaining ninety-nine. Fortunately, at least in General Delorme's opinion, such operations at the front are unnecessary; the surgeon's business is simply to see that the wounded are placed in the best circumstances to allow their natural recuperative powers to have the best chance of exerting themselves.

Much of the paper to which we have directed attention is of a purely technical nature and directly concerns only surgeons of the navy and army. But much of it concerns us all, and we are glad to think that as our arms of precision have improved our methods of treating the injuries produced by such improvements have not lagged behind.

NATURAL HISTORY, INFORMAL AND FORMAL.[1]

(1) THE first of the books before us aims rather at being a work of art than of natural history. It tells, with many a winding bout of linked fancy, of the yearnings of a boy and of a somewhat introspective stag. Never since the days of melancholy Jacques was such outpour of sentiment upon a stricken deer. To those who like this mood the book may be recommended, for it is curiously wrought and daintily embellished.

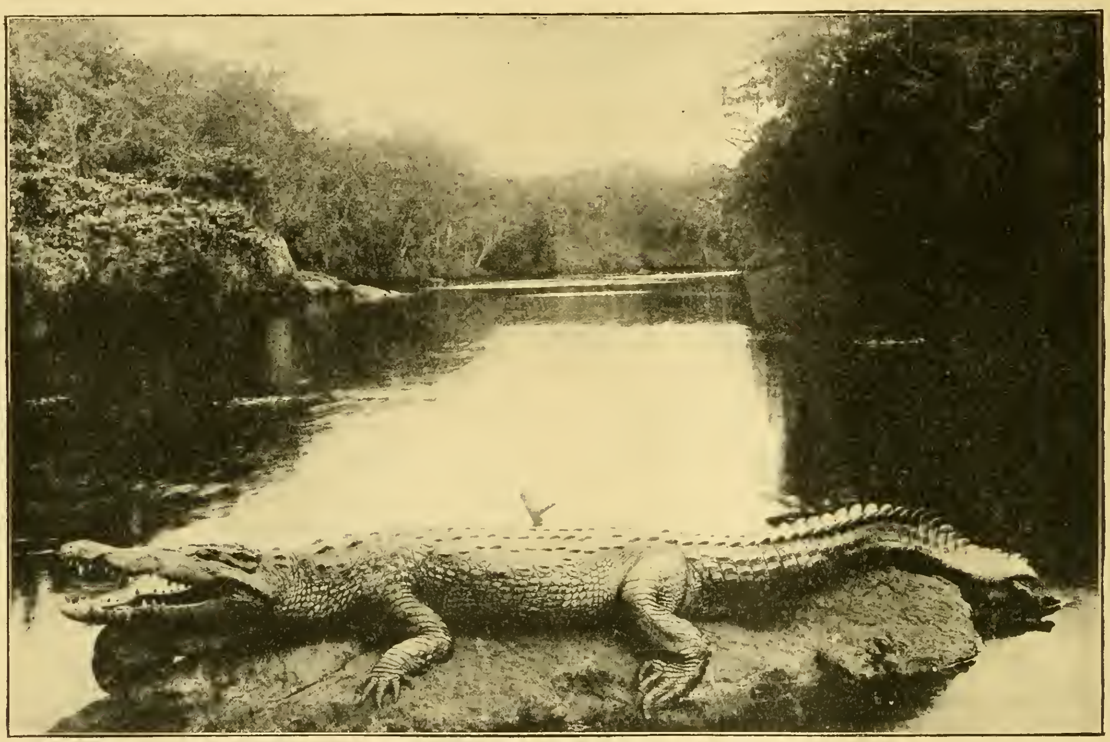
(2) The second book on the list strikes quite another strain: its author has certainly succeeded in his object, which is to introduce those of his fellow-creatures who love to live under the green-

[1] (1) "The Trail of the Sandhill Stag." By E. T. Seton. Pp. 93+plates. (London: Hodder and Stoughton, 1914.) Price 3*s*. 6*d*. net.
(2) "Wild Game in Zambezia." By R. C. F. Maugham. Pp. xii+376+plates. (London: John Murray, 1914.) Price 12*s*. net.
(3) "Animal Communities in Temperate America as Illustrated in the Chicago Region." A Study in Animal Ecology. By Dr. V. E. Shelford. Pp. xiii+362. (Chicago: University of Chicago Press; London: Cambridge University Press, n.d.) Price 12*s*. net.

wood tree to one of the few remaining regions of the earth where noble scenery is still unvulgarised and good shikar still unspoiled.

As a geographical expression, Zambezia is a little vague, but it appears from the companion map to include the Zambezi delta and the entire basin of the Zambezi system in the last five hundred miles of that great river's course. This country is said to contain every variety of climate and every beauty of African landscape. With the touch of a magician the author reveals tropical lowlands where vast seas of prairie, studded with islands of jungle, end in oceans of swamp and billowy sedge, the citadel of the water-birds—a very Nephelococcygia. Then up country he shows us the blue Zambezi, with many a feathery islet on her broad bosom, flowing through grassy plains and tranquil park-like expanses that lead into the forest primeval—gloomy shades made almost impenetrable by tangled creeper and thorny undergrowth, but breaking here and there into green pastures where the spongy soil is thickly printed with heart-thrilling spoor. Beyond the tropical jungle we pass to more temperately verdant hills, where cedar and bracken and the music of the waters call to mind the pine-woods of Scotland; and thence to rugged heights and clattered slopes and stark granite peaks that almost rival the Alps in grandeur and inspiration.

Of the fauna of this delightful land the author writes with discernment tempered with humour. He considers each species separately, in all its ways and bearings, from behemoth in the covert of the reed and fen to the coney that dwells among the rocks; if it be game, he has plenty of good stories to tell, in time and season, of its pursuit; and if it be an animal that can be made a pet of he can impart amusing information as to its manners and behaviour, good and bad. He also writes sensibly about game-reserves, tolerantly about the camera-sportsman, and with becoming scorn about the biltong-butcher. He has something to say about the tsetse-fly problem, and regards with unmeasured disapproval the barbarous proposals of those who think to settle it offhand by wholesale slaughter of game. It is to be wished that he could tell us something of the fly itself—whether we are, or are not, justified in assuming that an insect that produces a limited number of young, and nourishes them in her womb, must always carefully deposit them in some chosen habitat at that most critical period in their post-embryonic development when they become independent of her.



[Crocodile. From "Wild Game in Zambezia."]

Since he writes so methodically and scientifically of what he really knows, it is a pity that he sometimes wanders into the misty regions of pseudo-science, as when he discourses about the ancestry of the elephant, or gravely explains that since the horn of the rhinoceros consists of agglutinated hairs it has nothing in common with other horn.

The chapter on rifles and ammunition, tents, and all manner of equipment, camp regulations, etc., is full of most useful detail. But the list of stores required by two persons for a trip of two months is startling. It almost shakes one's confidence in the author to learn that he cannot go into camp with a friend for two months without a dozen tins each of lobster and salmon, two dozen tins of sausages, and three dozen tins of fruits in syrup.

The book is well printed and beautifully illustrated.

(3) The third book on the list reveals Science in her severest mood. The aim of this conscientious piece of work is to elevate the outdoor pursuit of natural history into a serious academic study embracing each and every species of animal in relation to its environment, particularly to its organic environment, and still more particularly in its relations of interdependence with other species of animals. It may almost be regarded as embodying a formulary or ritual of the precepts and principles shown forth in the third chapter of that immortal book, "The Origin of Species."

The author adheres firmly and steadily to the great truth that all the animals of a given habitat form a definite interdependent association; but his application of the term "community" to an assemblage bound by ties so non-moral implies a cynical view of the ethics of communal life in this twentieth century. He sets out to determine by a prolonged and detailed study of a given territory —its streams, ponds, lakes, swamps, prairie, thickets, forests, etc.—the salient impressive features of its different kinds of habitat, and the character and exact specific composition of the animal-associations appertaining to each. An incidental end is to teach the sentimental person "sanity towards nature," and to show the practical man that he himself has much to find out before he can learn any animal to be a toad. So far so good; but the esoteric terminology of it all is wondrous pitiful, and there is much dressing up of old plain truths in confusing folds of majestic language—such as the following:—"The breeding instincts are the centre about which all other activities of the organism rotate, and the breeding-place is the axis of the environmental relations of the organism."

THE TOTAL SOLAR ECLIPSE OF AUGUST 21.

WHILE a number of expeditions were organised, and some were dispatched, to observe the total solar eclipse on Friday last, August 21, many were unable to take up their stations owing to the upheaval now taking place in Europe. It is, therefore, with the greatest satisfaction that we learn of at least two expeditions which successfully reached their destinations and observed the eclipse under most favourable weather conditions. The two parties were the observers from the Royal Observatory, Greenwich, consisting of Messrs. Jones and Davidson, and the expedition sent out by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, composed of Fathers Cortie and O'Connor and Messrs. Atkinson and Gibbs.

According to a telegram to the *Daily Mail* of August 24, the Greenwich party, stationed at Minsk (Russia), observed the eclipse under good conditions in a clear sky, and photographs of both the corona and chromosphere were secured. It is stated that the form of the corona was of the intermediate type, *i.e.* of the square type, there being no large equatorial streamers or streamers in the regions of the solar poles. The corona is also stated to have been very bright. The party under Father Cortie, S.J., took up their position at Hernoesand in Sweden, and his telegram to the Royal Astronomical Society says, "Weather perfect. All operations successful. Intermediate corona."

It is interesting to mention that the Greenwich party was specially equipped for recording the ultra-violet spectrum of the chromosphere, while Father Cortie's instruments were more restricted to the yellow and red regions of the spectrum. Should the photographs turn out successful after development a wide range of the chromospheric spectrum will have been secured.

It is a great pity that Prof. Fowler was prevented from making any observations, for the interesting method of photographing the spectrum of the chromosphere for a long interval of time both before and after the total phase had every chance of being successfully tried.

ALFRED JOHN JUKES-BROWNE, F.R.S.

SELDOM has the triumph of force of will over the most serious disabilities been more strikingly illustrated than in the case of the subject of this notice. To most geologists engaged in field-work the loss of the full use of the limbs would seem to be fatal, but Jukes-Browne, in spite of all difficulties, continued his work as a geological surveyor for twenty years after the almost complete loss of his powers of locomotion.

Alfred John Browne was born near Wolverhampton in 1851; his mother was a sister of the distinguished geologist, J. Beete Jukes, whose work on the English and Irish geological surveys, and whose fame as a teacher in Dublin, are so well known; and young Browne, probably fired by his uncle's example, added the name of Jukes to his own as soon as he came of age.

After receiving his early education at Highgate, Jukes-Browne entered St. John's College, Cambridge, and, under the inspiring teaching and influence of Prof. T. G. Bonney, was able to add his name to the group of distinguished geologists who made that college famous during the last half of the nineteenth century. After a successful university career, Jukes-Browne joined the geological survey in 1874, and during the next nine years did good work in parts of East Anglia and Lincolnshire. But never, probably, a very strong man, the strenuous labours of a geological surveyor began to tell upon his health, enforcing retirement for a time.

Just at this period, however, a new and promising field of work opened out for the young geologist. The famous French palæontologist Hébert had shown, by the study of the fossils of the enormous deposits of chalk in his own country, that not only must the deposition of this thick formation have occupied vast periods of time, but that the changes taking place in the fauna during those periods furnish us with evidence by means of which the almost homogeneous mass of strata could be divided into a number of clearly recognisable "palæontological zones." Hébert's distinguished pupil, Prof. Charles Barrois, of Lille, by a general *reconnaissance* over the chalk areas in the British Isles, proved that these zones could be traced through the length and breadth of our land. Jukes-Browne took up the task of working out the details of this classification of the English chalk strata, and after traversing during nine years the Cretaceous areas of the south and west of England published his results in three volumes of the Survey Memoirs.

In the winter of 1888–9 the state of his health caused Jukes-Browne to go to Barbadoes; there he worked at his favourite studies with such good purpose as to be able to publish, in conjunction with Prof. J. B. Harrison, a most valuable description of the upraised oceanic deposits in that island.

Besides his survey memoirs, and many papers in scientific journals, Jukes-Browne wrote three geological text-books and a work of more general and speculative character, "The Building of the British Isles," and some of his books have passed through several editions. The value of his scientific labours was recognised by the award of the Murchison medal by the Geological Society and by his election to the Royal Society. In 1902 the state of his health compelled his retirement from the Geological Survey, and the last twelve years of his life were passed at Torquay, where he died on August 14. J. W. J.

NOTES.

A CENTRAL NEWS message from Melbourne on Tuesday, August 25, states that a number of members of the British Association attending the Australian meeting are curtailing their proposed tour and preparing for a speedy departure for England. Exactly what this message signifies is, however, not quite clear. The Sydney session did not begin until August 20, and the intention was to proceed to Brisbane afterwards, but the whole meeting was not to last more than about three weeks from August 8.

IT is reported in the *Times* that an oil well has been discovered at Muir of Ord, about ten miles' distance from Inverness, and that tests are being applied to discover the nature of the oil and its commercial value, if any.

THE outbreak of war has, of course, made it impossible for drugs to be obtained from Germany as has hitherto been the case. In this connection the Government has appointed a committee to consider questions in relation to the supply of drugs in the United Kingdom. The members of the committee are: Dr. J. Smith Whitaker, Sir Thomas Barlow, Sir Lauder Brunton, Dr. A. Cox, Prof. A. R. Cushny, Dr. E. Rowland Fothergill, Dr. B. A. Richmond, Dr. F. J. Smith, Dr. W. Hale White, with Dr. E. W. Adams as secretary.

THE Government of Madras recently undertook an investigation into the causation, prevention, and possible cure of diabetes, and secured the services of Dr. S. W. Patterson as investigator. We learn from the Allahabad *Pioneer Mail* that the sum of 50,000 rupees has been given by the Raja of Pithapuram for the purpose of carrying out the project, and that the Surgeon-General with the Government of Madras has been requested to submit to the Government by an early date proposals for providing Dr. Patterson with the necessary staff and laboratory accommodation.

THE twenty-fifth annual general meeting of the Institution of Mining Engineers will be held at Stoke-on-Trent on September 9, under the presidency of Sir W. E. Garforth, when the following papers will be read, or taken as read:—The absorption of oxygen by coal: part ii., the quantity of oxygen absorbed; part iii., the thermal value of the absorption; part iv., the influence of temperature; part vi., the ratio of spontaneous heating of coal, T. F. Winmill; the absorption of oxygen by coal, part v., the influence of temperature on the rates of absorption of different parts of the Barnsley Bed, J. I. Graham; self-contained rescue-apparatus and smoke-helmets for use in irrespirable atmospheres, Dr. J. S. Haldane; the unknown clays in coal-mines, Dr. J. W. Mellor.

IN the June number of *Folk-lore* Mr. J. H. Powell discusses the rite of hook-swinging in India. He describes, with numerous good photographs, the ceremony which he witnessed in the Manbhum district of Chota Nagpur in 1912; and he has collected accounts of the rite from that of Duarte Barbosa in Malabar down to recent times. He compares it with the meriah sacrifice of the Khonds, which Sir J. Frazer explains to be a fertility rite, and he regards it as a survival of human sacrifice. The facts recorded in the article are useful, and the argument is ingenious; but the object of the ceremony still remains obscure. On the analogy of other swinging rites in other parts of the world, it may be suggested that the rotation of the victim is intended to disperse, as a fertility charm, the *mana* of the performer, who by submitting to the rite is believed to be sacrosanct.

THE Congress of Archæological Societies, in issuing its report for the past year, directs attention to the passing into law of the Ancient Monuments Consolidation and Amendment Bill, and suggests that societies affiliated to the union, if they have no special earthworks section, should appoint some competent member to watch over the earthworks in their district. It announces with pleasure that steps have been taken to place Worlebury Camp, Somerset, under the protection of the Act, and that steps have been taken to stop the damage that was being done to Bokerly Dyke and some ancient remains near Bristol. But much destruction, as at the Burh of Edward the Elder at Witham, and of Whitehawk Camp near Brighton, still continues, and it is pointed out that the absence of power to compensate owners for loss incurred in the application of the Act is the weak point in the existing legislation on the subject.

MR. R. F. GILDER has issued a catalogue of the remains discovered in the course of a survey conducted by him of a series of prehistoric dwellings in Douglas and Sarpy Counties, Nebraska. There were believed to be depressions caused by bison wallowing in the mud, but are now proved to be of human origin. Along the Missouri river as far as the Platte some forty ruins have been explored, and the specimens collected are now deposited in the Omaha Public Library Museum. The collection consists of numerous articles made of bone and deer horn, pottery, prehistoric pipes, and various ornaments. The most remarkable object is a human head carved out of pink soapstone, which is believed by some competent archæologists to be unique among American collections.

WE have to acknowledge the receipt of a copy of the tenth part of Dr. Koningsberger's *Java*, the greater portion of which is devoted to the fauna of the coast region.

AN extraordinary destruction of gulls and other seabirds at Teesmouth, as the result of a thunderstorm accompanied by the fall of hail and lumps of clear ice, on July 2, is recorded in the August number of *British Birds*. The bodies of three hundred gulls were counted within a distance of three-quarters of a mile, exclusive of those by the side of the breakwater.

FROM the report for the year ending April 30, published in the July number of the *Victorian Naturalist*, we learn that the Victoria Field Naturalists' Club continues in a flourishing condition, although the attendance at the excursions has been diminished owing to the greater demands of military training. Special efforts were made in the matter of bird-protection and the prohibition of the feather-trade.

A SPECIAL double number (August and September) of the *Irish Naturalist* is devoted to an annotated list, by Mr. N. Colgan, of the opisthobranch molluscs to be found on the coast and adjacent shallow water of county Dublin. The Malahide River, or channel, by which the Malahide Creek is alternately filled and emptied, is a classic locality for these organisms, and was the source, in 1844, of specimens described by Alder and Hancock as new species.

Bird-lore for July and August contains a noteworthy letter from Mr. Abbott H. Thayer in regard to the alleged recent diminution in the numbers of the commoner birds in the United States. Impressed with the belief that the replies to question-lists issued to the general public are misleading, the author put himself in communication with Prof. H. Münsterberg, the Harvard psychologist, who unhesitatingly regards the answers as untrustworthy and the result of imagination.

THE Royal Zoological Society of New South Wales has started an illustrated journal of its own—the *Australian Zoologist*—of which the first number was published at Sydney in June. Among its contents is an article by the Rev. T. R. R. Stebbing on a third species of the exclusively Australian genus of caprelline marine crustaceans known as Paraproto. In a second Mr. A. R. McCulloch illustrates the remarkable sexual dimorphism of a pipe-fish, *Stigmatophora nigra*, and likewise describes, under the name of *Histiogamphelus briggsii*, a new generic and specific representative of the same group.

To the series of greatly enlarged models in the Natural History Museum illustrating the structure of insects and other invertebrates harmful to man or domesticated animals have been added several of the bont-tick (*Amblyoma hebraeum*), of southern and central Africa, which transmits heart-water to sheep, goats, and sometimes cattle. With one exception the models are twenty times natural size, and show the male and female under normal conditions, the fully-gorged female (a truly disgusting object), and the larva, the last represented by two models, are multiplied by 20 and the other 120. This interesting exhibit is at present placed in the central hall.

ANOTHER special exhibition in the central hall of the museum includes two cases—originally arranged for the conversazione in connection with the congress of dental surgeons—illustrating some of the most remarkable types of vertebrate dentition, both recent and fossil. The coiled dental spiral of Helicoprion and the button-like teeth of Lepidotus are noticeable in the fish series, while reptiles are represented, among others, by Placodus and Hyperodapedon, and mammals by the marsupial Thylacoleo, Arsinoëtherium, Toxodon, the primitive cetacean Prozeuglodon, and—most interesting of all—the head of a fœtal rorqual from South Georgia with the row of temporary teeth on either side of the upper jaw. Other preparations show the rise and development of the plates of whalebone which eventually cover the entire palate in this and other whalebone-whales.

THE "Report on Scottish Ornithology in 1913, including Migration," by Evelyn V. Baxter and Leonora Jeffrey Rintoul (Oliver and Boyd, Edinburgh; 1s. 6d. net), is a welcome publication. It summarises in convenient form the ornithological happenings in Scotland during the past year. Following the introductory remarks comes a section on species and subspecies new to Scotland, which is of special interest. The dusky willow-warbler (*Phylloscopus fuscatus*), an Asiatic species not hitherto recorded in any part of Europe, was met with on Auskerry on October 1. New to Scotland during the year, although previously recorded in England, were the lesser grey shrike, the melodious warbler, the Indian stonechat, the gull-billed tern, and the Scandinavian subspecies of the lesser black-backed gull. Scarcely less interesting are many of the records in the longer section on birds new to faunal areas, and uncommon visitors. In the section on extension of breeding range, we note that in 1913 the gadwall, the pintail, and the great crested grebe were all recorded for the first time as breeding species in the faunal area of "Moray." Among the notes in the section "Summer and Nesting" we find several relating to an unexplained scarcity of sea-fowl at various west coast breeding stations. There follow short sections on winter, ringing, plumage, and habits, etc., each of which contains a number of interesting records. A summary is then given of the course of migration during the year, a paragraph being devoted to each month. In the remaining two-thirds of this report of ninety-six pages we find a detailed list of the year's records arranged according to species. There is also an adequate index. The observers are to be congratulated on their effective report, the outstanding feature being the large number of uncommon visitors and the addition of no fewer than five new birds to the Scottish lists.

THE meteorological charts of the North Atlantic Ocean for August issued by the Meteorological Office and other institutions, show that ice conditions have considerably improved since the previous month. Bergs were only met with to any great extent north of 47° N.; the most westerly position in which field ice, with fragments of bergs embedded in it, was seen this year was 42° 18′ N., 62° 43′ W. The first issue (July 16) stated that mist and fog were prevalent at times, and extended up to the Arctic circle. During August, fog over the North Atlantic is in a transition stage; a remarkable feature is said to be its tendency to occur along the parallel of 20° N.

THE renewal of Antarctic exploration and research will bring into prominence the importance of the knowledge of ice conditions in the south polar regions. It is probably well known that the monthly meteorological charts of the Indian Ocean issued by the Meteorological Office usually contain particulars of icebergs of the southern hemisphere, with charts. The issue for September, *e.g.* gives tables of icebergs met with each month during the last twenty-nine years, and also between January and May of this year. The summaries published during past years show that the epochs of frequency are variable, and that bergs may be met anywhere poleward of the parallel of 30° S. Heights of from 800 to 1700 ft. are not uncommon, and in several instances the lengths have been estimated to extend to many miles. It is stated that, unfortunately, angular measurements are seldom recorded.

IN "La Forme de la Terre" (Paris: Hermann et Fils) Dr. Vérronet has written an extremely interesting note on the history of researches into the form of the earth's surface. Pythagoras, Eratosthenes, the forgotten Paris philosophers of the fourteenth century, and Fernel, all played a part in building up our present knowledge. But it is from the work of Cassini that modern geodesy may be said to date. The disagreement that he found between geodetic measures and the results of mathematical reasoning led the Paris Academy to send out an equatorial and a polar expedition to measure meridian arcs so as to settle whether the earth is an oblate or a prolate spheroid. The result then as afterwards more than once was to confirm the conclusions of the mathematicians. Lately a readjustment of geodetic measures has again been made, in terms of such hypotheses as isostasy, to bring the measured value of the earth's ellipticity into accord with the theoretical value deduced from the constant of precession. Despite the attempts at re-adjustment, Dr. Vérronet insists rightly that the ultimate decision must lie with the geodesist, as the value given by the constant of precession depends on the hypothesis that the internal constitution of the earth is essentially fluid. This would appear to be Dr. Vérronet's own view, and by the aid of it he indicates some interesting conclusions as to a belt of earthquake areas in the neighbourhood of latitude 35° (San Francisco, Lisbon, Sicily, Japan). The range of uncertainty is steadily diminishing, and the increased accuracy of the modern work is clearly indicated in the pamphlet. We note one small error—Huyford is spoken of as an English worker. The very brief criticism of Darwin's tidal friction as applied to cosmogony is not at all convincing, and should be either amplified or omitted in any subsequent edition.

A PAPER on the demagnetisation factors of cylindrical rods in high uniform fields, by the late Prof. B. O. Peirce, of Harvard, appears in the June number of the Proceedings of the American Academy. With the help of a large solenoid nearly two metres long, capable of producing a magnetic field of 2500 gauss at its centre, the magnetic flux for high fields through the various sections of rods of different lengths of the same material were measured. It was found that at fields of the order of 2500 gauss the rods need only have lengths about 25 or 30 diameters for the magnetic flux through the central section to be equal, to within a small faction of 1 per cent., to that which would be obtained with a rod of infinite length. If an accuracy of ½ per cent. only is required the rod need only be 15 diameters long. These conclusions have been verified on several specimens of soft iron and mild, tool, and magnet steel. For uniformity of field the magnetising coil should be about 25 of its own diameters longer than the test piece.

ONE of the most interesting cases of the presence of abnormal constituents in the urine occurs in *pentosuria*, when pentoses or five-carbon sugars are found in considerably quantity. Since the work of Neuberg in 1900, the pentose present in such cases has generally been regarded as *dl*-arabinose. Messrs. E. Zerner and R. Woltuch, in the *Sitzungsberichte* of the Vienna Academy of Sciences (vol. cxxii., p. 879), now bring forward good evidence to show that in two cases they have studied the sugar is *d*-xylose. In these cases the urine showed considerable reducing power, but no rotatory power. The osazone isolated had the same melting-point as ordinary *l*-xylosazone, but an opposite (positive) rotation; when the osazone was mixed with *l*-xylosazone the melting-point of the mixture rose 40°—a behaviour which is good evidence of its being *d*-xylosazone. The occurrence of *d*-xylose under such conditions is a striking example of abnormal metabolism, especially as the ordinary form of xylose which occurs in plant-materials is the lævo-form.

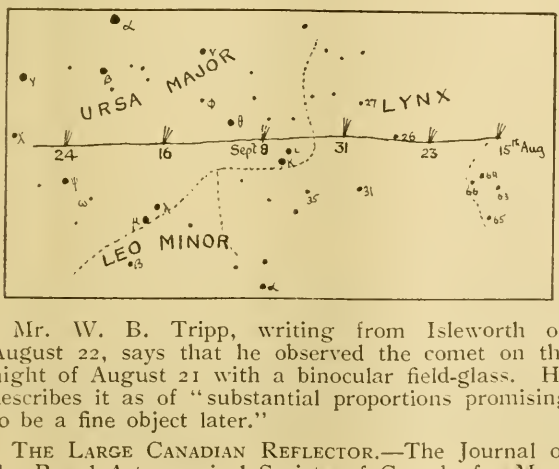
THE *Engineer* for August 7 contains an account of a fireless locomotive built by Messrs. Andrew Barclay, Sons and Co., Ltd., of Kilmarnock, and supplied to the Admiralty for service at one of the explosive depôts, where the question of absolute safety from fire is of the first importance. The locomotive has a reservoir partly filled with water, and is charged with high-pressure steam from a boiler placed outside the danger zone. It can work on one charge of the reservoir for several hours on continuous hauling, or for a much longer time on ordinary shunting work. It can stand for twelve hours in ordinary open-air temperature with small loss of steam, and can run back to the charging station under the very low pressure of 15 lb. per square inch. All the test conditions were more than fulfilled at the trials. The engine is not only fireless, but the rubbing surfaces, such as the brake blocks, and the impact points, such as the buffers, have been rendered sparkless by the use of special facings.

The lack of supplies of glass and porcelain from Germany and Austria, on account of the war, has affected various businesses depending upon them. We are informed, however, by the Thermal Syndicate, Ltd., manufacturers of pure fused silica, that it is still in a position to supply its "Vitreosil" ware promptly, as this substitute for porcelain and glass is made entirely in the works of the syndicate at Wallsend-on-Tyne.

"The Report of the Fourteenth Meeting of the Australasian Association for the Advancement of Science" has been recently issued by the Association from its permanent office in Sydney. It is edited by Dr. T. S. Hall, and contains a full account of the proceedings of the meeting held at Melbourne in 1913.

OUR ASTRONOMICAL COLUMN.

Comet 1913*f* (Delavan).—Little news is at hand concerning observations of Delavan's comet. During the present week the object will be situated in the constellation of the Lynx pursuing a course nearly midway between the stars 27 and 31 in that constellation, and at right angles to a line joining these two stars. The small chart below, given previously in this column on August 13, is reproduced here again for reference:—



Mr. W. B. Tripp, writing from Isleworth on August 22, says that he observed the comet on the night of August 21 with a binocular field-glass. He describes it as of "substantial proportions promising to be a fine object later."

The Large Canadian Reflector.—The Journal of the Royal Astronomical Society of Canada for May–June (vol. viii., No. 3) contains two illustrated articles dealing with the proposed site and the observing conditions for the large 72-in. reflector; these are contributed by Messrs. W. E. Harper and J. S. Plaskett. An examination of the seeing conditions of many scattered regions has resulted in the choice of a hill, Little Saanich, 732 ft. high, situated seven and a half miles from Victoria. While Mr. Harper admits that the transparency of the air at the Lick Observatory is superior to any place examined by him in Canada, he holds the opinion that in the matter of low temperature range and the character of the seeing itself conditions may be looked for to equal those upon Mount Hamilton. The Government of British Columbia has considered the whole project in a broad-minded way and agreed to provide 10,000 dollars for the purchase of the land and to build a road to the summit of the hill. Fifty acres of land have been secured. As regards the instrument itself, the disc for the mirror is ready for shipment, and it is stated that there is every prospect of the telescope being ready for erection next year. Messrs. Warner and Swasey are the constructors, and Mr. Plaskett says that he is in the highest degree delighted with their work, and firmly convinced that "this telescope in rigidity, suitability, and convenience will be away ahead of any hitherto built."

Rapid Convection in Stellar Atmospheres.—In this column for April 30 of this year (vol. xciii., p. 224) reference was made to the new interpretation to the observed displacements of the solar lines suggested by Mr. Evershed. The observations were explained by a very rapid descent of the cooler gases and vapours upon the body of the sun, most rapid in the higher levels, and less rapid as the successively lower levels were reached, combined with small effects due to pressures less than one atmosphere. Prof. W. W. Campbell points out (Lick Observatory Bulletin, No. 257) that these observations give us apparently a measure of the general convectional circulation in the sun's atmosphere, which, if confirmed, "must be considered as of very great importance." These considerations lead him to inquire into what may be occurring in the atmosphere of other suns. Assuming that surface temperatures of stars must be largely a function of their convection-activity, a sluggish star, *i.e.* one with little convection, should have a relatively cool surface, while a massive star, approximating to a perfect gas, should have a large convection and have relatively a hot surface. Having found that the radial velocities of Class B stars are observed about 4·5 km. a second too great (then attributed to pressure in the absorbing layers), Prof. Campbell, in the light of Evershed's results as regards the solar atmosphere, puts forward the view that this excess is probably due to the existence of relatively unobstructed radial circulation. This circulation would bring the internal heat to the surface, with little loss of time, to replenish loss by radiations to surrounding space. If the sun's atmosphere, which is sluggish, can account for a speed of 1 km. a second, a relatively hot star like those of Class B might rationally have a velocity of 4·5 km. a second.

A Novel Combination of Instruments.—Dr. Frank Schlesinger in the Publications of the Allegheny Observatory (vol. iii., No. 13), gives an account of the solar spectrograph of that observatory and the vertical telescope with which it is used. These instruments are the gift of the Hon. H. Kirke Porter, and they form part of the Keeler memorial telescope. The Keeler memorial telescope is a 30-in. reflector, and its mounting is used not only as a polar heliostat carrying an 18-in. mirror, but as a coelostat also with an 18-in. mirror. The telescope is mounted on a tall pillar circular at its upper end, and the dome is raised correspondingly high. Round the upper portion of this pillar is a strong lattice work structure, capable of rotation round the pillar, and to this is fixed the vertical telescope with a second mirror and the objective at its upper end, the lower end carrying the large spectroscope, the collimator of which is vertical. For different declinations of the object under investigation the vertical telescope can be moved round in azimuth. In the communication in question Dr. Schlesinger describes all the chief portions of the instruments in detail, and numerous reproductions accompany the text. The latter part of the paper contains an investigation on the rotation of the sun by spectroscopic means made with the instrument described briefly above. Reference should be made to the paper itself for details, but the interesting table, showing the formulæ derived for the solar rotation by the spectroscopic method, may be here reproduced :—

	Formula	Equatorial Velocity km.
Duner	$14°·81 - 4°·2 \sin^2\phi$	2·09
Halm	14·53 − 2·5	2·05
Adams	14·54 − 3·5	2·05
Storey and Wilson	14·75 − 3·2	2·08
Plaskett	14·37 − 4·0	2·02
De Lury	14·04 − 4·0	1·97
Hubrecht	13·23 − 3·2	1·86
Evershed and Royds	13·77	1·94
Schlesinger	14·17 − 3·4	2·00

It should be stated that Duner's and Halm's observations were visual, and that Hubrecht found a difference of 0·8° between the coefficients of $\sin^2\phi$ for the two solar hemispheres and the value given above is the mean. Dr. Schlesinger is strongly of the opinion that the causes of the diversity of the results are due to systematic errors at the telescope and at the measuring machine.

FLUCTUATIONS IN THE YIELD OF SEA FISHERIES.[1]

THERE can be little doubt that this report by Dr. Hjort will mark an epoch in the history of scientific fishery investigations. If the arguments upon which its conclusions are based successfully withstand the test of criticism, there has been established a method of predicting the probable future course from year to year of some of our most important fisheries, which should be of the utmost value both to those engaged practically in the fishing industry and to those responsible for fishery administration.

The report is the result of many years of observation, and although the lines upon which the work has proceeded, and the character of the results which were expected, have been described by Dr. Hjort and his fellow-workers from time to time, this is the first report in which the whole matter has been brought forward in a comprehensive way, and the first time that all the data upon which the conclusions are based have been available. It is now possible to form a judgment as to the value of the work already done and as to the promise which it holds out of still more useful results in the future.

It is one of the most characteristic features of the great sea fisheries that they are subject to remarkable fluctuations from time to time. Sometimes these fluctuations are seasonal, sometimes annual, but more often, perhaps, we have a series of years of successful fishery, followed by another series of comparatively lean years. These fluctuations are especially noticeable in the case of the fisheries for the so-called pelagic fish, such as the herring, mackerel, pilchard, and anchovy, and, to a less-marked degree, in the case of the cod and haddock. Dr. Hjort's principal results refer to the herring, but a considerable amount of attention has also been given by him and his colleagues to the cod and haddock.

The case of the herring is the most conclusive. The main evidence has been obtained by the determination of the age of the fish from the markings on the scale. As in the case of many other fishes, there is little or no growth of the fish during the winter, and the difference in growth between winter and summer is clearly marked on the scale of the fish, the period of small winter growth being represented by a dark mark or ring. By counting the number of such rings the age of the fish can be determined, so that the year in which it was born becomes known. In a sample of the fish taken at any particular time it is therefore possible to determine in what proportions the different year classes are represented.

This method of age analysis has now been applied to Norwegian herring for a series of years with somewhat remarkable results. It has been found during the period 1907 to 1914 that fish of the year class 1904, that is to say, fish born in the year 1904, have occupied a very prominent position throughout, at first forming a large proportion of the shoals of smaller herring ("fat herring" as they are called in Norway, fish from 19–26 cm., still quite immature), and in later years being equally prominent amongst the larger fish ("large herring," fish from 27–32 cm., and "spring herring," the actually spawning fish). The following table shows the percentage of fish of the 1904 year class in the samples examined each year from 1907 to 1913 :—

Per cent. 1904	in 1907	1908	1909	1910	1911	1912	1913
Among fat herring ...	51·3	37·8	16·9	4·5	0	0	0
Among large herring	7·7	51·6	48·8	59·6	46·0	52·5	58·6
Among spring herring	1·6	34·8	43·7	77·3	70·0	64·3	64·7

The 1904 fish, therefore, formed more than 50 per cent. of the immature "fat herring" in 1907, and occurred amongst this class of fish in diminishing proportion until 1910. Amongst the "large herring," 51·6 per cent. were 1904-spawned fish already in 1908, and fish of the same year class occurred in large proportions each year until 1913, when there were still 58·6 per cent. Turning to the "spring herring"—the large spawning fish—the 1904 group was represented each year by a larger percentage, until in 1910 it constituted 77·3 per cent. of all the fish. Since that time the percentage has only slightly fallen off, being still 64·7 per cent. in 1913. In the last chapter of the report the figures for 1914 are given, the percentages of the different year groups amongst the spring fish being as follows (p. 219) :—

Spring Fish, 1914. *Total number of Herrings examined* 2205.

Age in Years...	4	5	6	7	8	9
Year of Birth ..	1910	1909	1908	1907	1906	1905
Percentage of fish in each age group	0·6	3·3	6·9	5·2	7·2	13·9
Age in Years...	10	11	12	13	14	15
Year of Birth	1904	1903	1902	1901	1900	1899
Percentage of fish in each age group	54·3	5·0	1·5	1·2	0·4	0·5

In the year 1914, therefore, we still have, in the samples examined, 54·3 per cent. of the fish derived from the spawning of the year 1904. It should be added that the 2,205 fish are the combined total of eight samples taken at different points on the Nor-

[1] Fluctuations in the great fisheries of Northern Europe viewed in the light of biological research. By Johan Hjort. Con. perm. internat. Explor. Mer. Rapp. et proc. verb. XX. Copenhagen, 1914.

wegian coast, and that each individual sample shows the same predominance of the 1904 class. It is also equally well shown in seven samples of "large herring" taken during the winter of 1913–14.

The next step in Dr. Hjort's argument is based on a study of the fishery statistics showing the fluctuations in the total yield of herrings of the different kinds. He is able to show that a marked increase of the yield occurred in those years in which the 1904 class became prominent.

The report then goes on to a study of the cod and haddock, and evidence is produced of a similar series of phenomena in the case of these fish. Again, the 1904 year class is predominant for a number of years, and its abundance gives rise to a successful fishery.

Summing up the whole matter, Dr. Hjort claims that the renewal of the stock of fish does not take place, as in any human population, by means of a more or less constant annual increment in the form of new individuals, but that, in the case of the species investigated, it is of a highly irregular character. "At certains intervals, year classes arise which far exceed the average in point of numbers, and during their lifetime, this numerical superiority affects the general character of the stock, both as regards quantity and quality, thus again exerting a decisive influence upon the yield of the fisheries in both respects." These rich year classes make their presence felt when they are still quite young, and their influence on the yield of the fisheries extends through a number of years. It should, therefore, in future, by means of properly organised investigations, be possible to ascertain beforehand the probable general course of the fisheries over a series of years. Such predictions will, of course, be liable to be upset by special circumstances, both of a general and of a local character. Nevertheless, there is now good reason to hope that indications of great practical value may be given, if the methods of investigation advocated by Dr. Hjort are continued upon an adequate scale. E. J. A.

STUDIES OF TROPICAL DISEASES.[1]

THIS report consists of the report of the committee (2 pp.) and six appendices, the first of which deals with anti-malarial measures in the Crown Colonies and protectorates, etc., the remainder with reports of the work done in various laboratories. To consider, first, Appendix I. The data in this appendix are mainly statistical. They seem to us to be deficient in two ways. (1) The figures are not scrupulously accurate, or at least differ from other official figures. (2) Information is lacking which seems to be essential to an appreciation of the meaning of the figures. Of want of accuracy, the following are examples. On p. 11 in the Mauritius report the number of deaths ascribed to fever (malaria *included*) is given as 4498, whereas in the annual report for Mauritius the deaths due to malaria *only* are given as 4619. Again, under the heading, "Government Hospitals," we find malarial fever: admissions 2321, deaths 30, whereas in the annual report for Mauritius we find 3063 cases of malaria, and 43 deaths. The discrepancy here may be due to the fact that in the latter case other than hospital cases are recorded, but if this is so, at any rate they find no place among the data in this report.

Again, comparing the figures given in this report and in the annual medical report for the Straits Settlements, we find the figures for malarial admissions to be 9172 and 9474 respectively, a difference of 302. In the corresponding reports for Nyasaland we find the population given as 1,000,659 and 1,001,895 respectively. In the Southern Nigerian report (p. 35) we find the following puzzling figures under malarial fever, viz.:—Admissions, 6; deaths, 10; admissions, 7; deaths, 5; admissions, 1; deaths, 10. And again, under "Government Hospitals," we find the admissions given as 9687, and two lines further down as 1365! Under "Blackwater Fever" four deaths are recorded, but no admissions are given, and it is only by referring to the annual medical report that we find that the number of cases in the colony was twenty-three. Not to pursue the subject further, we would only add that in our opinion the heading, "Deaths Ascribed to Fever," is ambiguous, as apparently some medical officers have found it to be, for some change the heading to "Malaria Fever," others say "malaria included," whereas others again subdivide it into malaria, typhoid, and non-specified fevers. We think this heading should be changed to "Diseases During the Year," and divided into various sub-headings, *e.g.* malarial fever, blackwater fever, etc., with the addition, if necessary, of unclassified fevers, and in each instance where possible cases as well as deaths recorded, as is done under heading 6 "Government Hospitals."

The second criticism we have to make is that information is lacking which is necessary to give the figures their full value. While dreading to suggest any addition to the really burdensome labours of those who have to compile these reports, yet we cannot help feeling that a mere record of population and malarial deaths tells us less than we ought to know. In our opinion, for these figures to be really of value we should know, besides the total population, that of each race and the deaths in each race. For instance, we are given, on p. 14, the European, Chinese, "other races," and Malay population of the Straits Settlements, but while we are told that the total births are more than 20,000, we are given no idea as to what races were responsible, and similarly we cannot tell among what populations the malarial deaths occurred. We have dwelt on these points because it seems to us that sooner or later the question of the compilation of the figures in reports of this kind and in the annual medical reports must be seriously considered. It is scarcely an exaggeration, we think, to say that at present no two annual medical reports are based on exactly the same plan, and we actually find that the official year is not identical in all. One point will not be disputed, viz., that absolute accuracy is necessary, and this is by no means an easy matter to attain, as everybody knows who has had to make up tables of figures. Whether these matters should not be in the hands of trained statistical officers, instead of being thrown on the shoulders of already overworked medical officers is a matter for consideration.

It is impossible to give shortly an adequate notice of the various researches recorded in appendices ii.–vi., as the subjects differ widely. It is evident that much valuable research is being done and interesting results got, but it occurs to us whether practical results—and we think we may assume that this is the main object of most of these researches—could not be got more quickly if the forces now scattered in various directions were to some extent concentrated on certain problems. For instance, we consider that each of the reports on the use of salvarsan in yaws (three in number) is more valuable than it would have been if it had stood alone. On ankylostomiasis we have only one report. It would be a gain to check the results recorded in it by experience elsewhere. So while not wishing to limit in any way a man's predilection, we think that coordination would be of advantage. The report is priced at 2*s*. 4*d*., but we hope that every medical officer receives a copy gratis. J. W. W. S.

[1] Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1913.

SOLIDIFICATION OF METALS.

THE first Report to the Beilby Prize Committee of the Institute of Metals on "The Solidification of Metals from the Liquid State," by Dr. C. H. Desch, is published in the current number of the Journal of the Institute. It consists of a very interesting and comprehensive review of the literature bearing on the subject, in conformity with the first part of the scheme of Dr. Beilby, which included both the preparation of a summary of the existing knowledge on the subject of the solidification of metals and an experimental investigation of certain parts of the subject. The report deals first with the cellular structure of metals, and it is shown that more than one apparently cellular structure may be detected in metals under suitable conditions. The crystallisation of metals is next approached, and the formation of crystallites or crystal skeletons. Attention is very rightly directed to the few opportunities which occur for the goniometrical and physical study of isolated crystals of metals. For there can be no doubt that much valuable information would be obtained from such an investigation, which would also be of particular value as throwing light on the phenomenon of hardness. In a solidifying metal crystallites start at numerous independent centres, and each grows as a crystal until interfered with by its neighbours, which interference gives rise to the so-called "allotriomorphic" formations of irregularly bounded crystals.

The foam-structure theory of Quincke is next dealt with, and shown to be carried much too far in its application to metals; for the theory affords no explanation of the absolutely firmly established geometrical properties of crystals. Cellular structures in cooling liquids are next described, and then comes a most interesting section on liquid crystals, in which it is pleasant to see that Dr. Desch gives full credit to the marvellously detailed work of Lehmann, who has now established it beyond doubt that there are substances, usually organic, which unite the properties of a crystal and a liquid, and that a definite arrangement of the molecules may persist in the liquid state.

The influence of surface tension is then discussed, and the existence of a metastable limit in the case of undercooling, together with the phenomenon of change of volume on solidification. Finally, the possibility of a thrust being exerted by growing crystals is debated from the evidence available, and the fact pointed out that there is yet no clear evidence of any effect which cannot be attributed to change of volume during change of state. The net result of the report is to indicate the immense field open for investigation, and one which has bearings, not only on pure science, but on industrial problems of the greatest importance and magnitude.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

INAUGURAL ADDRESS BY PROF. WILLIAM BATESON, M.A., F.R.S., PRESIDENT.

PART II.—SYDNEY.

AT Melbourne I spoke of the new knowledge of the properties of living things which Mendelian analysis has brought us. I indicated how these discoveries are affecting our outlook on that old problem of natural history, the origin and nature of species, and the chief conclusion I drew was the negative one, that, though we must hold to our faith in the evolution of species, there is little evidence as to how it has come about, and no clear proof that the process is continuing in any considerable degree at the present time. The thought uppermost in our minds is that knowledge of the nature of life is altogether too slender to warrant speculation on these fundamental subjects. Did we presume to offer such speculations they would have no more value than those which alchemists might have made as to the nature of the elements. But though in regard to these theoretical aspects we must confess to such deep ignorance, enough has been learnt of the general course of heredity within a single species to justify many practical conclusions which cannot in the main be shaken. I propose now to develop some of these conclusions in regard to our own species, Man.

In my former Address I mentioned the condition of certain animals and plants which are what we call "polymorphic." Their populations consist of individuals of many types, though they breed freely together with perfect fertility. In cases of this kind which have been sufficiently investigated it has been found that these distinctions—sometimes very great and affecting most diverse features of organisation—are due to the presence or absence of elements, or factors as we call them, which are treated in heredity as separate entities. These factors and their combinations produce the characteristics which we perceive. No individual can acquire a particular characteristic unless the requisite factors entered into the composition of that individual at fertilisation, being received either from the father or from the mother or from both, and consequently no individual can pass on to his offspring positive characters which he does not himself possess. Rules of this kind have already been traced in operation in the human species; and though I admit that an assumption of some magnitude is involved when we extend the application of the same system to human characteristics in general, yet the assumption is one which I believe we are fully justified in making. With little hesitation we can now declare that the potentialities and aptitudes, physical as well as mental, sex, colours, powers of work or invention, liability to diseases, possible duration of life, and the other features by which the members of a mixed population differ from each other, are determined from the moment of fertilisation; and by all that we know of heredity in the forms of life with which we can experiment we are compelled to believe that these qualities are in the main distributed on a factorial system. By changes in the outward conditions of life the expression of some of these powers and features may be excited or restrained. For the development of some an external opportunity is needed, and if that be withheld the character is never seen, any more than if the body be starved can the full height be attained; but such influences are superficial and do not alter the genetic constitution.

The factors which the individual receives from his parents and no others are those which he can transmit to his offspring; and if a factor was received from one parent only, not more than half the offspring, on an average, will inherit it. What is it that has so long prevented mankind from discovering such simple facts? Primarily the circumstance that as man must have *two* parents it is not possible quite easily to detect the contributions of each. The individual body is a *double* structure, whereas the germ-cells are *single*. Two germ-cells unite to produce each individual body, and the ingredients they respectively contribute interact in ways that leave the ultimate product a medley in which it is difficult to identify the several ingredients. When, however, their effects are conspicuous the task is by no means impossible. In part also even physiologists have been blinded by the survival of ancient and obscurantist conceptions of the nature of man by which they were discouraged from the application of any rigorous analysis. Medical literature still abounds with traces of these archaisms, and, indeed, it is only quite recently that prominent horse-breeders have come to see that the dam matters as much as the sire. For them, though vast pecuniary considerations were involved, the old "homunculus" theory was good enough. We were amazed at the notions of genetic physiology which Prof. Baldwin Spencer encountered in his wonderful researches among the natives of Central Australia; but in truth, if we reflect that these problems have engaged the attention of civilised man for ages, the fact that he, with all his powers of recording and deduction, failed to discover any part of the Mendelian system is almost as amazing. The popular notion that any parents can have any kind of children within the racial limits is contrary to all experience, yet we have gravely entertained such ideas. As I have said elsewhere, the truth might have been found out at any period in the world's history if only pedigrees had been drawn the right way up. If, instead of exhibiting the successive pairs of progenitors who have contributed to the making of an ultimate individual, some one had had the idea of setting out the posterity of a single ancestor who possessed a marked feature such as the Habsburg lip, and showing the transmission of this feature along some of the descending branches and the permanent loss of the feature in collaterals, the essential truth that heredity can be expressed in terms of presence and absence must have at once become apparent. For the descendant is not, as he appears in the conventional pedigree, a sort of pool into which each tributary ancestral stream has poured something, but rather a conglomerate of ingredient-characters taken from his progenitors in such a way that some ingredients are represented and others are omitted.

Let me not, however, give the impression that the unravelling of such descents is easy. Even with fairly full details, which in the case of man are very rarely to be had, many complications occur, often preventing us from obtaining more than a rough general indication of the system of descent. The nature of these complications we partly understand from our experience of animals and plants which are amenable to breeding under careful restrictions, and we know that they are mostly referable to various effects of interaction between factors by which the presence of some is masked.

Necessarily the clearest evidence of regularity in the inheritance of human characteristics has been obtained in regard to the descent of marked abnormalities of structure and congenital diseases. Of the descent of ordinary distinctions such as are met with in the normal healthy population we know little for certain. Hurst's evidence, that two parents both with light-coloured eyes—in the strict sense, meaning that no pigment is present on the front of the iris—do not have dark-eyed children, still stands almost alone in this respect. With regard to the inheritance of other colour-characteristics some advance has been made, but everything points to the inference that the genetics of colour and many other features in man will prove exceptionally complex. There are, however, plenty of indications of system comparable with those which we trace in various animals and plants, and we are assured that to extend and clarify such evidence is only a matter of careful analysis. For the present, in asserting almost any general rules for human descent, we do right to make large reservations for possible exceptions. It is tantalising to have to wait, but of the ultimate result there can be no doubt.

I spoke of complications. Two of these are worth illustrating here, for probably both of them play a great part in human genetics. It was discovered by Nilsson-Ehle, in the course of experiments with certain wheats, that several factors having the same power may co-exist in the same individual. These cumulative factors do not necessarily produce a cumulative effect, for any one of them may suffice to give the full result. Just as the pure-bred tall pea with its two factors for tallness is no taller than the cross-bred with a single factor, so these wheats with three pairs of factors for red colour are no redder than the ordinary reds of the same family. Similar observations have been made by East and others. In some cases, as in the Primulas studied by Gregory, the effect is cumulative. These results have been used with plausibility by Davenport and the American workers to elucidate the curious case of the mulatto. If the descent of colour in the cross between the negro and the white man followed the simplest rule, the offspring of two first-cross mulattos would be, on an average, one black: two mulattos: one white, but this is notoriously not so. Evidence of some segregation is fairly clear, and the deficiency of real whites may perhaps be accounted for on the hypothesis of cumulative factors, though by the nature of the case strict proof is not to be had. But at present I own to a preference for regarding such examples as instances of imperfect segregation. The series of germ-cells produced by the cross-bred consists of some with no black, some with full black, and others with intermediate quantities of black. No statistical tests of the condition of the gametes in such cases exist, and it is likely that by choosing suitable crosses all sorts of conditions may be found, ranging from the simplest case of total segregation, in which there are only two forms of gametes, up to those in which there are all intermediates in various proportions. This at least is what general experience of hybrid products leads me to anticipate. Segregation is somehow effected by the rhythms of cell-division, if such an expression may be permitted. In some cases the whole factor is so easily separated that it is swept out at once; in others it is so intermixed that gametes of all degrees of purity may result. That is admittedly a crude metaphor, but as yet we cannot substitute a better. Be all this as it may, there are many signs that in human heredity phenomena of this kind are common, whether they indicate a multiplicity of cumulative factors or imperfections in segregation. Such phenomena, however, in no way detract from the essential truths that segregation occurs, and that the organism cannot pass on a factor which it has not itself received.

In human heredity we have found some examples, and I believe that we shall find many more, in which the descent of factors is limited by sex. The classical instances are those of colour-blindness and hæmophilia. Both these conditions occur with much greater frequency in males than in females. Of colour-blindness at least we know that the *sons* of the colour-blind man do not inherit it (unless the mother is a transmitter) and do not transmit it to their children of either sex. Some, probably all, of the daughters of the colour-blind father inherit the character, and though not themselves colour-blind, they transmit it to some (probably, on an average, half) of their offspring of both sexes. For since these normal-sighted women have only received the colour-blindness from one side of their parentage, only half their offspring, on an average, can inherit it. The sons who inherit the colour-blindness will be colour-blind, and the inheriting daughters become themselves again transmitters. Males with normal colour-vision, whatever their own parentage, do not have colour-blind descendants, unless they marry transmitting women. There are points still doubtful in the interpretation, but the critical fact is clear, that the germ-cells of the colour-blind man are of two kinds: (i) those which do not carry on the affection and are destined to take part in the formation of sons; and (ii) those which do carry on the colour-blindness and are destined to form daughters. There is evidence that the ova also are similarly predestined to form one or other of the sexes, but to discuss the whole question of sex-determination is beyond my present scope. The descent of these sex-limited affections nevertheless calls for mention here, because it is an admirable illustration of factorial predestination. It moreover exemplifies that *parental polarity* of the zygote to which I alluded in my first Address, a phenomenon which we suspect to be at the bottom of various anomalies of heredity, and suggests that there may be truth in the popular notion that in some respects sons resemble their mothers and daughters their fathers.

As to the descent of hereditary diseases and malformations, however, we have abundant data for deciding that many are transmitted as dominants and a few as recessives. The most remarkable collection of these data is to be found in family histories of diseases of the eye. Neurology and dermatology have also contributed many very instructive pedigrees. In great measure the ophthalmological material was collected by Edward Nettleship, for whose death we so lately grieved. After retiring from practice as an oculist he devoted several years to this most laborious task. He was not content with hearsay evidence, but travelled incessantly, personally examining all accessible members of the families concerned, working in such a way that his pedigrees are models of orderly observation and recording. His zeal stimulated many younger men to take part in the work, and it will now go on, with the result that the systems of descent of all the common hereditary diseases of the eye will soon be known with approximate accuracy.

Give a little imagination to considering the chief deduction from this work. Technical details apart, and granting that we cannot wholly interpret the numerical results, sometimes noticeably more and sometimes fewer descendants of these patients being affected than Mendelian formulæ would indicate, the expectation is that in the case of many diseases of the eye a large proportion of the children, grandchildren, and remoter descendants of the patients will be affected with the disease. Sometimes it is only defective sight that is transmitted; in other cases it is blindness, eiher from birth or coming on at some later age. The most striking example perhaps is that of a form of night-blindness still prevalent in a district near Montpellier, which has affected at least 130 persons, all descending from a single affected individual[1] who came into the country in the seventeenth century. The transmission is in every case through an affected parent, and no normal has been known to pass on the condition. Such an example well serves to illustrate the fixity of the rules of descent. Similar instances might be recited relating to a great variety of other conditions, some trivial, others grave.

At various times it has been declared that men are born equal, and that the inequality is brought about by unequal opportunities. Acquaintance with the pedigrees of disease soon shows the fatuity of such fancies. The same conclusion, we may be sure, would result from the true representation of the descent of any human faculty. Never since Galton's publications can the matter have been in any doubt. At the time he began to study family histories even the broad significance of heredity was frequently denied, and resemblances to parents or ancestors were looked on as interesting curiosities. Inveighing against hereditary political institutions, Tom Paine remarks that the idea is as absurd as that of an "hereditary wise man," or an "hereditary mathematician," and to this day I suppose many people are not aware that he is saying anything more than commonly foolish. We, on the contrary, would feel it something of a puzzle if two parents, both mathematically gifted, had any children *not* mathematicians. Galton first demonstrated the overwhelming importance of these considerations, and had he not been misled, partly by the theory of pangenesis, but more by his mathematical instincts and training, which prompted him to apply statistical treatment rather than qualitative analysis, he might, not improbably, have discovered the essential facts of Mendelism.

It happens rarely that science has anything to offer to the common stock of ideas at once so comprehensive and so simple that the courses of our thoughts are changed. Contributions to the material progress of mankind are comparatively frequent. They result at once in application. Transit is quickened; communication is made easier; the food-supply is increased and population multiplied. By direct application to the breeding of animals and plants such results must even flow from Mendel's work. But I imagine the greatest practical change likely to ensue from modern genetic discovery will be a quickening of interest in the true nature of man and in the biology of races. I have spoken cautiously as to the evidence for the operation of any simple Mendelian system in the descent of human faculty; yet the certainty that systems which differ from the simpler schemes only in degree of complexity are at work in the distribution of characters among the human population cannot fail to influence our conceptions of life and of ethics, leading perhaps ultimately to modification of social usage. That change cannot but be in the main one of simplification. The eighteenth century made great pretence of a return to nature, but it did not occur to those philosophers first to inquire what nature is; and perhaps not even the patristic writings contain fantasies much further from physiological truth than those which the rationalists of the "Encyclopædia" adopted as the basis of their social schemes. For men are so far from being born equal or similar that to the naturalist they stand as the very type of a polymorphic species. Even most of our local races consist of many distinct strains and individual types. From the population of any ordinary English town as many distinct human breeds could in a few generations be isolated as there are now breeds of dogs, and indeed such a population in its present state is much what the dogs of Europe would be in ten years' time but for the interference of the fanciers. Even as at present constituted, owing to the isolating effects of instinct, fashion, occupation, and social class, many incipient strains already exist.

In one respect civilised man differs from all other species of animal or plant in that, having prodigious and ever-increasing power over nature, he invokes these powers for the preservation and maintenance of many of the inferior and all the defective members of his species. The inferior freely multiply, and the defective, if their defects be not so grave as to lead to their detention in prisons or asylums, multiply also without restraint. Heredity being strict in its action,

[1] The first human descent proved to follow Mendelian rules was that of a serious malformation of the hand studied by Farabee in America. Drinkwater subsequently worked out pedigrees for the same malformation in England. After many attempts, he now tells me that he has succeeded in proving that the American family and one of his own had an abnormal ancestor in common, five generations ago.

the consequences are in civilised countries much what they would be in the kennels of the dog-breeder who continued to preserve all his puppies, good and bad: the proportion of defectives increases. The increase is so considerable that outside every great city there is a smaller town inhabited by defectives and those who wait on them. Round London we have a ring of such towns with some 30,000 inhabitants, of whom about 28,000 are defective, largely, though of course by no means entirely, bred from previous generations of defectives. Now, it is not for us to consider practical measures. As men of science we observe natural events and deduce conclusions from them. I may perhaps be allowed to say that the remedies proposed in America, in so far as they aim at the eugenic regulation of marriage on a comprehensive scale, strike me as devised without regard to the needs either of individuals or of a modern State. Undoubtedly if they decide to breed their population of one uniform puritan grey, they can do it in a few generations; but I doubt if timid respectability will make a nation happy, and I am sure that qualities of a different sort are needed if it is to compete with more vigorous and more varied communities. Everyone must have a preliminary sympathy with the aims of eugenists both abroad and at home. Their efforts at the least are doing something to discover and spread truth as to the physiological structure of society. The spirit of such organisations, however, almost of necessity suffers from a bias towards the accepted and the ordinary, and if they had power it would go hard with many ingredients of society that could be ill-spared. I notice an ominous passage in which even Galton, the founder of eugenics, feeling perhaps some twinge of his Quaker ancestry, remarks that "as the Bohemianism in the nature of our race is destined to perish, the sooner it goes, the happier for mankind." It is not the eugenists who will give us what Plato has called divine releases from the common ways. If some fancier with the catholicity of Shakespeare would take us in hand, well and good; but I would not trust even Shakespeares meeting as a committee. Let us remember that Beethoven's father was an habitual drunkard and that his mother died of consumption. From the genealogy of the patriarchs also we learn—what may very well be the truth—that the fathers of such as dwell in tents, and of all such as handle the harp or organ, and the instructor of every artificer in brass and iron—the founders, that is to say, of the arts and the sciences—came in direct descent from Cain, and not in the posterity of the irreproachable Seth, who is to us, as he probably was also in the narrow circle of his own contemporaries, what naturalists call a *nomen nudum*.

Genetic research will make it possible for a nation to elect by what sort of beings it will be represented not very many generations hence, much as a farmer can decide whether his byres shall be full of shorthorns or Herefords. It will be very surprising indeed if some nation does not make trial of this new power. They may make awful mistakes, but I think they will try.

Whether we like it or not, extraordinary and far-reaching changes in public opinion are coming to pass. Man is just beginning to know himself for what he is—a rather long-lived animal, with great powers of enjoyment if he does not deliberately forgo them. Hitherto superstition and mythical ideas of sin have predominantly controlled these powers. Mysticism will not die out: for those strange fancies knowledge is no cure; but their forms may change, and mysticism as a force for the suppression of joy is happily losing its hold on the modern world. As in the decay of earlier religions Ushabti dolls were substituted for human victims, so telepathy, necromancy, and other harmless toys take the place of eschatology and the inculcation of a ferocious moral code. Among the civilised races of Europe we are witnessing an emancipation from traditional control in thought, in art, and in conduct which is likely to have prolonged and wonderful influences. Returning to freer or, if you will, simpler conceptions of life and death, the coming generations are determined to get more out of this world than their forefathers did. Is it then to be supposed that when science puts into their hand means for the alleviation of suffering immeasurable, and for making this world a happier place, that they will demur to using those powers? The intenser struggle between communities is only now beginning, and with the approaching exhaustion of that capital of energy stored in the earth before man began it must soon becomes still more fierce. In England some of our great-grandchildren will see the end of the easily accessible coal, and, failing some miraculous discovery of available energy, a wholesale reduction in population. There are races who have shown themselves able at a word to throw off all tradition and take into their service every power that science has yet offered them. Can we expect that they, when they see how to rid themselves of the ever-increasing weight of a defective population, will hesitate? The time cannot be far distant when both individuals and communities will begin to think in terms of biological fact, and it behoves those who lead scientific thought carefully to consider whither action should lead. At present I ask you merely to observe the facts. The powers of science to preserve the defective are now enormous. Every year these powers increase. This course of action must reach a limit. To the deliberate intervention of civilisation for the preservation of inferior strains there must sooner or later come an end, and before long nations will realise the responsibility they have assumed in multiplying these "cankers of a calm world and a long peace."

The definitely feeble-minded we may with propriety restrain, as we are beginning to do even in England, and we may safely prevent unions in which both parties are defective, for the evidence shows that as a rule such marriages, though often prolific, commonly produce no normal children at all. The union of such social vermin we should no more permit than we would allow parasites to breed on our own bodies. Further than that in restraint of marriage we ought not to go, at least not yet. Something too may be done by a reform of medical ethics. Medical students are taught that it is their duty to prolong life at whatever cost in suffering. This may have been right when diagnosis was uncertain and interference usually of small effect; but deliberately to interfere now for the preservation of an infant so gravely diseased that it can never be happy or come to any good is very like wanton cruelty. In private few men defend such interference. Most who have seen these cases lingering on agree that the system is deplorable, but ask where can any line be drawn. The biologist would reply that in all ages such decisions have been made by civilised communities with fair success both in regard to crime and in the closely analogous case of lunacy. The real reason why these things are done is because the world collectively cherishes occult views of the nature of life, because the facts are realised by few, and because between the legal mind—to which society has become accustomed to defer—and the seeing eye, there is such physiological antithesis that scarcely can they be combined in the same body. So soon as scientific knowledge becomes common property, views more reasonable and, I may add, more humane, are likely to prevail.

To all these great biological problems that modern society must sooner or later face there are many aspects besides the obvious ones. Infant mortality we are asked to lament without the slightest thought of what the world would be like if the majority of these infants were to survive. The decline in the birth-rate in countries already over-populated is often deplored, and we are told that a nation in which population is not rapidly increasing must be in a decline. The slightest acquaintance with biology, or even school-boy natural history, shows that this inference may be entirely wrong, and that before such a question can be decided in one way or the other, hosts of considerations must be taken into account. In normal stable conditions population is stationary. The laity never appreciates, what is so clear to a biologist, that the last century and a quarter, corresponding with the great rise in population, has been an altogether exceptional period. To our species this period has been what its early years in Australia were to the rabbit. The exploitation of energy-capital of the earth in coal, development of the new countries, and the consequent pouring of food into Europe, the application of antiseptics, these are the things that have enabled the human population to increase. I do not doubt that if population were more evenly spread over the earth it might increase very much more; but the essential fact is that under any stable conditions a limit must be reached. A pair of wrens will bring off a dozen young every year, but each year you will find the same number of pairs in your garden. In England the limit beyond which under present conditions of distribution increase of population is a source of suffering rather than of happiness has been reached already. Younger communities living in territories largely vacant are very probably right in desiring and encouraging more population. Increase, may, for some temporary reason, be essential to their prosperity. But those who live, as I do, among thousands of creatures in a state of semi-starvation will realise that too few is better than too many, and will acknowledge the wisdom of Ecclesiasticus who said "Desire not a multitude of unprofitable children."

But at least it is often urged that the decline in the birth-rate of the intelligent and successful sections of the population—I am speaking of the older communities—is to be regretted. Even this cannot be granted without qualification. As the biologist knows, differentiation is indispensable to progress. If population were homogeneous civilisation would stop. In every army the officers must be comparatively few. Consequently, if the upper strata of the community produce more children than will recruit their numbers some must fall into the lower strata and increase the pressure there. Statisticians tell us that an average of four children under present conditions is sufficient to keep the number constant, and as the expectation of life is steadily improving we may perhaps contemplate some diminution of that number without alarm.

In the study of history biological treatment is only beginning to be applied. For us the causes of the success and failure of races are physiological events, and the progress of man has depended upon a chain of these events, like those which have resulted in the "improvement" of the domesticated animals and plants. It is obvious, for example, that had the cereals never been domesticated cities could scarcely have existed. But we may go further, and say that in temperate countries of the Old World (having neither rice nor maize) populations concentrated in large cities have been made possible by the appearance of a "thrashable" wheat. The ears of the wild wheats break easily to pieces, and the grain remains in the thick husk. Such wheat can be used for food, but not readily. Ages before written history began, in some unknown place, plants, or more likely a plant, of wheat lost the dominant factor to which this brittleness is due, and the recessive, thrashable wheat resulted. Some man noticed this wonderful novelty, and it has been disseminated over the earth. The original variation may well have occurred once only, in a single germ-cell.

So must it have been with Man. Translated into terms of factors, how has that progress in control of nature which we call civilisation been achieved? By the sporadic appearance of variations, mostly, perhaps all, consisting in a loss of elements, which inhibit the free working of the mind. The members of civilised communities, when they think about such things at all, imagine the process a gradual one, and that they themselves are active agents in it. Few, however, contribute anything but their labour; and except in so far as they have freedom to adopt and imitate, their physiological composition is that of an earlier order of beings. Annul the work of a few hundreds—I might almost say scores—of men, and on what plane of civilisation should we be? We should not have advanced beyond the medieval stage without printing, chemistry, steam, electricity, or surgery worthy the name. These things are the contributions of a few excessively rare minds. Galton reckoned those to whom the term "illustrious" might be applied as one in a million, but in that number he is, of course, reckoning men famous in ways which add nothing to universal progress. To improve by subordinate invention, to discover details missed, even to apply knowledge never before applied, all these things need genius in some degree, and are far beyond the powers of the average man of our race; but the true pioneer, the man whose penetration creates a new world, as did that of Newton and of Pasteur, is inconceivably rare. But for a few thousands of such men, we should perhaps be in the Palæolithic era, knowing neither metals, writing, arithmetic, weaving, nor pottery.

In the history of art the same is true, but with this remarkable difference, that not only are gifts of artistic creation very rare, but even the faculty of artistic enjoyment, not to speak of higher powers of appreciation, is not attained without variation from the common type. I am speaking, of course, of the non-Semitic races of modern Europe, among whom the power whether of making or enjoying works of art is confined to an insignificant number of individuals. Appreciation can in some degree be simulated, but in our population there is no widespread physiological appetite for such things. When detached from the centres where they are made by others most of us pass our time in great contentment, making nothing that is beautiful, and quite unconscious of any deprivation. Musical taste is the most notable exception, for in certain races—for example, the Welsh and some of the Germans—it is almost universal. Otherwise artistic faculty is still sporadic in its occurrence. The case of music well illustrates the application of genetic analysis to human faculty. No one disputes that musical ability is congenital. In its fuller manifestation it demands sense of rhythm, ear, and special nervous and muscular powers. Each of these is separable and doubtless genetically distinct. Each is the consequence of a special departure from the common type. Teaching and external influences are powerless to evoke these faculties, though their development may be assisted. The only conceivable way in which the people of England, for example, could become a musical nation would be by the gradual rise in the proportional numbers of a musical strain or strains until the present type became so rare as to be negligible. It by no means follows that in any other respect the resulting population would be distinguishable from the present one. Difficulties of this kind beset the efforts of anthropologists to trace racial origins. It must continually be remembered that most characters are independently transmitted and capable of such recombination. In the light of Mendelian knowledge the discussion whether a race is pure or mixed loses almost all significance. A race is pure if it breeds pure and not otherwise. Historically we may know that a race like our own was, as a matter of fact, of mixed origin. But a character may have been introduced by a single individual, though subsequently it becomes common to the race. This is merely a variant on the familiar paradox that in the course of time if registration is accurate we shall all have the same surname. In the case of music, for instance, the gift, originally perhaps from a Welsh source, might permeate the nation, and the question would then arise whether the nation, so changed, was the English nation or not.

Such a problem is raised in a striking form by the population of modern Greece, and especially of Athens. The racial characteristics of the Athenian of the fifth century B.C. are vividly described by Galton in "Hereditary Genius." The fact that in that period a population, numbering many thousands, should have existed, capable of following the great plays at a first hearing, revelling in subtleties of speech, and thrilling with passionate delight in beautiful things, is physiologically a most singular phenomenon. On the basis of the number of illustrious men produced by that age Galton estimated the average intelligence as at least two of his degrees above our own, differing from us as much as we do from the negro. A few generations later the display was over. The origin of that constellation of human genius which then blazed out is as yet beyond all biological analysis, but I think we are not altogether without suspicion of the sequence of the biological events. If I visit a poultry-breeder who has a fine stock of thoroughbred game fowls breeding true, and ten years later—that is to say ten fowl-generations later—I go again and find scarcely a recognisable game-fowl on the place, I know exactly what has happened. One or two birds of some other or of no breed must have strayed in and their progeny been left undestroyed. Now in Athens we have many indications that up to the beginning of the fifth century so long as the phratries and gentes were maintained in their integrity there was rather close endogamy, a condition giving the best chance of producing a homogeneous population. There was no lack of material from which intelligence and artistic power might be derived. Sporadically these qualities existed throughout the ancient Greek world from the dawn of history, and, for example, the vase-painters, the makers of the Tanagra figurines, and the gem-cutters were presumably pursuing family crafts, much as are the actor-families[2] of England or the professorial families of Germany at the present day. How the intellectual strains should have acquired predominance we cannot tell, but in an in-breeding community homogeneity at least is not surprising. At the end of the sixth century came the "reforms" of Cleisthenes (507 B.C.), which sanctioned foreign marriages and admitted to citizenship a number not only of resident aliens but also of manumitted slaves. As Aristotle says, Cleisthenes legislated with the deliberate purpose of breaking up the phratries and gentes, in order that the various sections of the population might be mixed up as much as possible, and the old tribal associations abolished. The "reform" was probably a recognition and extension of a process already begun; but is it too much to suppose that we have here the effective beginning of a series of genetic changes which in a few generations so greatly altered the character of the people? Under Pericles the old law was restored (451 B.C.), but losses in the great wars led to further laxity in practice, and though at the end of the fifth century the strict rule was re-enacted that a citizen must be of citizen-birth on both sides, the population by that time may well have become largely mongrelised.

Let me not be construed as arguing that mixture of races is an evil: far from it. A population like our own, indeed, owes much of its strength to the extreme diversity of its components, for they contribute a corresponding abundance of aptitudes. Everything turns on the nature of the ingredients brought in, and I am concerned solely with the observation that these genetic disturbances lead ultimately to great and usually unforeseen changes in the nature of the population.

Some experiments of this kind are going on at the present time, in the United States, for example, on a very large scale. Our grand-children may live to see the characteristics of the American population entirely altered by the vast invasion of Italian and other South European elements. We may expect that the Eastern States, and especially New England, the people of which still exhibit the fine Puritan qualities with their appropriate limitations, absorbing little of the alien elements, will before long be in feelings and aptitudes very notably differentiated from the rest. In Japan, also, with the abolition of the feudal system and the rise of commercialism, a change in population has begun which may be worthy of the attention of naturalists in that country. Till the revolution the Samurai almost always married within their own class, with the result, as I am informed, that the caste had fairly recognisable features. The changes of 1868 and the consequent impoverishment of the Samurai have brought about a beginning of disintegration which may not improbably have perceptible effects.

How many genetic vicissitudes has our own peerage undergone! Into the hard-fighting stock of medieval and Plantagenet times have successively been crossed the cunning shrewdness of Tudor statesmen and courtiers, the numerous contributions of Charles II. and his concubines, reinforcing peculiar and persistent attributes which popular imagination especially regards as the characteristic of peers, ultimately the heroes of finance and industrialism. Definitely intellectual elements have been sporadically added, with rare exceptions, however, from the ranks of lawyers and politicians. To this aristocracy art, learning, and science have contributed sparse ingredients, but these mostly chosen for celibacy or childlessness. A remarkable body of men, nevertheless; with an average "horse-power," as Samuel Butler would have said, far exceeding that of any random sample of the middle-class. If only man could be reproduced by budding what a simplification it would be! In vegetative reproduction heredity is usually complete. The Washington plum can be divided to produce as many identical individuals as are required. If, say, Washington, the statesman, or preferably King Solomon, could similarly have been propagated, all the nations of the earth could have been supplied with ideal rulers.

Historians commonly ascribe such changes as occurred in Athens, and will almost certainly come

[2] For tables of these families, see the Supplement to "Who's Who in the Theatre."

to pass in the United States, to conditions of life and especially to political institutions. These agencies, however, do little unless they are such as to change the breed. External changes may indeed give an opportunity to special strains, which then acquire ascendency. The industrial developments which began at the end of the eighteenth century, for instance, gave a chance to strains till then submerged, and their success involved the decay of most of the old aristocratic families. But the demagogue who would argue from the rise of the one and the fall of the other that the original relative positions were not justifiable altogether mistakes the facts.

Conditions give opportunities but cause no variations. For example, in Athens, to which I just referred, the universality of cultivated discernment could never have come to pass but for the institution of slavery which provided the opportunity, but slavery was in no sense a cause of that development, for many other populations have lived on slaves and remained altogether inconspicuous.

The long-standing controversy as to the relative importance of nature and nurture, to use Galton's "convenient jingle of words," is drawing to an end, and of the overwhelmingly greater significance of nature there is no longer any possibility of doubt. It may be well briefly to recapitulate the arguments on which naturalists rely in coming to this decision both as regards races and individuals. First as regards human individuals, there is the common experience that children of the same parents reared under conditions sensibly identical may develop quite differently, exhibiting in character and aptitudes a segregation just as great as in their colours or hair-forms. Conversely all the more marked aptitudes have at various times appeared and not rarely reached perfection in circumstances the least favourable for their development. Next, appeal can be made to the universal experience of the breeder, whether of animals or plants, that strain is absolutely essential, that though bad conditions may easily enough spoil a good strain, yet that under the best conditions a bad strain will never give a fine result. It is faith, not evidence, which encourages educationists and economists to hope so greatly in the ameliorating effects of the conditions of life. Let us consider what they can do and what they cannot. By reference to some sentences in a charming though pathetic book, "What Is, and What Might Be," by Mr. Edmond Holmes, which will be well known in the Educational Section, I may make the point of view of us naturalists clear. I take Mr. Holmes's pronouncement partly because he is an enthusiastic believer in the efficacy of nurture as opposed to nature, and also because he illustrates his views by frequent appeals to biological analogies which help us to a common ground. Wheat badly cultivated will give a bad yield, though, as Mr. Holmes truly says, wheat of the same strain in similar soil well cultivated may give a good harvest. But, having witnessed the success of a great natural teacher in helping unpromising peasant children to develop their natural powers, he gives us another botanical parallel. Assuming that the wild bullace is the origin of domesticated plums, he tells us that by cultivation the bullace can no doubt be improved so far as to become a better bullace, but by no means can the bullace be made to bear plums.

All this is sound biology; but translating these facts into the human analogy, he declares that the work of the successful teacher shows that with man the facts are otherwise, and that the *average* rustic child, whose normal ideal is "bullacehood," can become the rare exception, developing to a stage corresponding with that of the plum. But the naturalist knows exactly where the parallel is at fault. For the wheat and the bullace are both breeding approximately true, whereas the human crop, like jute and various cottons, is in a state of polymorphic mixture. The population of many English villages may be compared with the crop which would result from sowing a bushel of kernels gathered mostly from the hedges, with an occasional few from an orchard. If anyone asks how it happens that there are any plum-kernels in the sample at all, he may find the answer perhaps in spontaneous variation, but more probably in the appearance of a long-hidden recessive. For the want of that genetic variation, consisting probably, as I have argued, in loss of inhibiting factors, by which the plum arose from the wild form, neither food, nor education, nor hygiene can in any way atone. Many wild plants are half-starved through competition, and transferred to garden soil they grow much bigger; so good conditions might certainly enable the bullace population to develop beyond the stunted physical and mental stature they commonly attain, but plums they can never be. Modern statesmanship aims rightly at helping those who have got sown as wildings to come into their proper class; but let not anyone suppose such a policy democratic in its ultimate effects, for no course of action can be more effective in strengthening the upper classes whilst weakening the lower.

In all practical schemes for social reform the congenital diversity, the essential polymorphism of all civilised communities must be recognised as a fundamental fact, and reformers should rather direct their efforts to facilitating and rectifying class-distinctions than to any futile attempt to abolish them. The teaching of biology is perfectly clear. We are what we are by virtue of our differentiation. The value of civilisation has in all ages been doubted. Since, however, the first variations were not strangled in their birth, we are launched on that course of variability of which civilisation is the consequence. We cannot go back to homogeneity again, and differentiated we are likely to continue. For a period measures designed to create a spurious homogeneity may be applied. Such attempts will, I anticipate, be made when the present unstable social state reaches a climax of instability, which may not be long hence. Their effects can be but evanescent. The instability is due not to inequality, which is inherent and congenital, but rather to the fact that in periods of rapid change like the present, convection-currents are set up such that the elements of the strata get intermixed and the apparent stratification corresponds only roughly with the genetic. In a few generations under uniform conditions these elements settle in their true levels once more.

In such equilibrium is content most surely to be expected. To the naturalist the broad lines of solution of the problems of social discontent are evident. They lie neither in vain dreams of a mystical and disintegrating equality, nor in the promotion of that malignant individualism which in older civilisations has threatened mortification of the humbler organs, but rather in a physiological co-ordination of the constituent parts of the social organism. The rewards of commerce are grossly out of proportion to those attainable by intellect or industry. Even regarded as compensation for a dull life, they far exceed the value of the services rendered to the community. Such disparity is an incident of the abnormally rapid growth of population and is quite indefensible as a permanent social condition. Nevertheless, capital, distinguished as a provision for offspring, is a eugenic institution; and unless human instinct undergoes some profound and improbable variation, abolition of capital means the abolition of effort; but as in the body the power of independent growth of the parts is limited and subordinated to the whole, similarly in the community we may limit the powers of capital, preserving so much inequality of privilege as corresponds with physiological fact.

At every turn the student of political science is confronted with problems that demand biological knowledge for their solution. Most obviously is this true in regard to education, the criminal law, and all those numerous branches of policy and administration which are directly concerned with the physiological capacities of mankind. Assumptions as to what can be done and what cannot be done to modify individuals and races have continually to be made, and the basis of fact on which such decisions are founded can be drawn only from biological study.

A knowledge of the facts of nature is not yet deemed an essential part of the mental equipment of politicians; but as the priest, who began in other ages as medicine-man, has been obliged to abandon the medical parts of his practice, so will the future behold the schoolmaster, the magistrate, the lawyer, and ultimately the statesman, compelled to share with the naturalist those functions which are concerned with the physiology of race.

SECTION B.

CHEMISTRY.

Opening Address by Prof. William J. Pope, M.A., LL.D., F.R.S., President of the Section.

(*Concluded from p.* 649.)

The two assemblages can now be described in a quantitative manner by stating the symmetry and also the relative dimensions of each. The cubic assemblage exhibits symmetry identical with that of the cube or the regular octahedron, a symmetry characteristic of so-called holohedral cubic crystals; the relative dimensions in different directions are defined by the symmetry. The assemblage can, in fact, be referred to three axes parallel to the edges of a cube, and as these directions are obviously similar in a cube, their ratios are of the form, $a:b:c=1:1:1$. This expression indicates that if the assemblage, supposed indefinitely extended through space, is moved by a unit distance in either of the three rectangular directions, a, b, and c, the effect, as examined from any point, is as if the assemblage had not been moved at all.

The symmetry of the hexagonal assemblage is identical with that of a hexagonal prism or of a double hexagonal pyramid, and is that characteristic of the so-called holohedral, hexagonal, crystalline system; the relative dimensions are no longer defined entirely by the symmetry, and are conveniently stated as the ratio of the diameter, a, of the prism or pyramid, to the height, c, of the pyramid. The ratio, $a:c$, for the assemblage of spheres under discussion can be calculated; it assumes two forms, corresponding to two modes of selecting alternative principal diameters of the prism as unit. The alternative ratios are: $a:c=1:1{\cdot}6330$ or $a:c=1:1{\cdot}4142$.

This somewhat lengthy theoretical discussion has now reached a stage at which it can be applied to the observed facts; the accompanying table (Table I.) states the mode in which crystalline substances of different degrees of molecular complexity distribute themselves amongst the various crystal systems. Of the elements which have been crystallographically examined, 50 per cent. are cubic, whilst a further 35 per cent. are hexagonal; and consideration of the data for these latter shows that they exhibit approximately the axial ratios characteristic of the hexagonal closest-packed assemblage; thus magnesium shows $a:c=1:1{\cdot}6242$, and arsenic the ratio $a:c=1{\cdot}4025$.

Table I.

System.	Inorganic substances, the number of atoms in the molecule of which is respectively:						Organic Substances
	Elements	2	3	4	5	More than 5	
	Per cent.						
Cubic	50	68·5	42	5	12	5·8	2·5
Hexagonal ..	35	19·5	11	35	38	14·6	4·0
Tetragonal ...	5	4·5	19	5	6	7	5·0
Orthorhombic ...	5	3·0	23·5	50	36	27·3	34·0
Monosymmetric	5	4·5	3	5	6	37·3	47·5
Anorthic ...	0	0	1·5	0	2	8	7·0
No. of cases examined for each vertical column	140	67	63	20	50	673	585

Whilst the crystal structure of some 85 per cent. of the crystalline elements seems to be in general agreement with the simple assumption of equilibrium which has been made, the divergence presented by about 15 per cent. of the elements still awaits explanation. The previous discussion applies to the theoretically simple case of a monatomic element; many of the elements are, however, certainly polyatomic. Imagine, therefore, that in the crystal structure, agreeing with the cubic or hexagonal arrangement just described, the similar atoms are grouped to form complex molecules, each containing two or more atoms; the geometrical effect of this grouping, if any, should be, first, to degrade the symmetry of the structure, and, secondly, to slightly alter its relative dimensions. It would therefore be expected that if the elements which are neither cubic nor hexagonal owe their departure from those systems to molecular aggregation, the crystal dimensions should approximate closely to those of the two ideal assemblages; this is, indeed, found to be the case. Monosymmetric sulphur, for instance, exhibits the axial ratios, $a:b:c=0{\cdot}9958:1:0{\cdot}9988$, $\beta=95^\circ\ 46'$; the relative dimensions in the three directions a, b, and c, are almost the same as in the cubic system, and the angle between the directions a and c is $\beta=95^\circ\ 46'$, instead of 90°. This substance has nearly the dimensions of a cubic crystal, and is obviously "pseudo-cubic"; the same is true of all other elements which depart from true cubic or hexagonal symmetry.

The crystalline forms presented by the elements are consequently in accordance with the assumption that the crystal structures are equilibrium arrangements of the component atoms of the two kinds described. It is also indicated that aggregation of the atoms to form molecular complexes is responsible for the departure from simple cubic or hexagonal symmetry; in this connection it is interesting to note that the strongly coloured elements depart most widely from these two systems. Thus, the colourless modifications of carbon and phosphorus are cubic, whilst the black graphite is monosymmetric and the red phosphorus is orthorhombic in crystal form; this is in accordance with the general view that colour is the result of some particular kind of molecular aggregation.

Although so much general correspondence of a quantitative character is to be observed between the observed facts and the anticipations developed from the equilibrium assumption, it has become evident during the last year or two that the conception formed as to the nature of the equilibrium which determines the arrangement of the atoms in a crystalline element is of too simple a character. In 1912 Laue showed that on passing a narrow pencil of X-rays through a crystal plate the emergent rays were capable of forming a regular, geometrical pattern of spots upon a photographic plate placed to receive the emergent beam; the pattern of spots thus produced was in agreement with the symmetry of the direction in the crystal plate in which the beam was passed. This discovery was developed and very considerably extended by Bragg, who was able to show that an X-ray beam undergoes reflection at the surface of a crystal plate. The interpretation of the novel results indicates that the homogeneous crystal structure acts upon the X-ray beam much as a solid diffraction grating might be expected to do, and that each deflected transmitted ray is a reflection from one set of parallel planes of atoms in the crystal.

The experimental and theoretical study of the X-ray effects has been prosecuted with brilliant success by W. H. and W. L. Bragg, the result being that a method is now available which makes it possible to determine, with very great probability, the actual arrangement of the constituent atoms in crystal structure. Sufficient time has not yet elapsed for the thorough exploitation of this new and fruitful field of research, but many data are available already for comparison with the conclusions drawn from the consideration of the equilibria possible in crystal structures; it is found that the two methods do not at once lead to identical conclusions. Thus, in accordance with the first method, the structure of the diamond would be indicated at some slight modification of the cubic closest-packed assemblage of equal spheres, the modification consisting in the main of a grouping of sets of atoms which leads to the partial cubic symmetry which the diamond apparently exhibits; one particular mode of grouping which leads to the required result consists in supposing the carbon atoms formed into sets of four, tetrahedrally arranged, two oppositely orientated sets of such tetrahedral groups being distinguished. If each of these tetrahedral groups be replaced by a single point situated at the group-centre, the structure which the Bragg experiments indicate for the diamond is obtained.

The simple geometrical relationship which thus exists between the two suggested structures for diamond raises a suspicion that the particular form in which the assumption of equilibrium is stated requires qualification: that possibly the domain of the carbon atom when packed with others, as in the diamond, does not become converted into a rhombic dodecahedron, but into a polyhedron roughly tetrahedral in shape.

Leaving this particular point for the moment and turning again to Table I., it is seen that the binary compounds, like the elements, also tend to crystallise in the cubic or hexagonal systems; the axial ratios of the hexagonal binary compounds approximate very closely to the value, $a : c = 1 : 1{\cdot}6330$, calculated for the closest-packed, hexagonal assemblage of equal spheres. The values of c/a for all the known cases are: BeO – 1·6365, ZnO – 1·6077, ZnS – 1·6350, CdS – 1·6218, and AgI – 1·6392.

Assemblages representing the crystal structures of the cubic and hexagonal binary compounds may be derived from the two closest-packed assemblages of similar spheres already described, by homogeneously replacing one half of the spheres by different ones of the same size. The degrees of symmetry presented by these arrangements are not so high as those of the unsubstituted assemblages; this is in accordance with the fact that the crystals themselves have not the full symmetry of the holohedral cubic or hexagonal system. Thus, on warming a hexagonal crystal of silver iodide, one end of the principal axis c becomes positively, and the other negatively, electrified. The axis c is thus a polar axis, having different properties at its two ends; this axis will be found to be polar in the model. Again, when hexagonal silver iodide is heated to 145°, it changes its crystalline form and becomes cubic; this so-called polymorphous change can be imitated in the hexagonal model by slightly shifting each pair of layers of spheres in the assemblage.

A very close agreement thus exists between the properties of the assemblages deduced and the observed properties of those binary compounds which crystallise in the cubic or hexagonal systems. The remaining 12 per cent. or so are not, in general, pseudo-cubic or pseudo-hexagonal, and it is noteworthy that they comprise those binary compounds in which the two component elements have not the same lowest valency; amongst them are the substances of the compositions, PbO, FeAs, HgO, AsS, and CuO.

On comparing the structures of the binary crystalline compounds indicated by the foregoing method of consideration with those deduced by the Braggs, discrepancies are again obvious; again, however, the former assemblage is converted into the latter by replacing groups of spheres by their group-centres. The relation thus rendered apparent is once more a suggestion that the type of equilibrium conditions originally assumed is too simple. It will be seen, however, that the Bragg results furnish a proof of one part of the assumption made concerning equilibrium, namely, that each component atom operates separately; the discussion of the properties of crystals on the assumption that the crystal structure may be regarded as built up of similar mass-points, due to the mathematical physicists of the last century, therefore requires to be reopened. Thus, the Bragg structure of rock-salt is represented by dividing space into equal cubes by three sets of parallel planes and replacing the cube corners encountered along the directions of the cube edges by chlorine and sodium atoms alternately; each chlorine atom then has six sodium atoms as its nearest and equally distant neighbours. With which of the latter the one chlorine atom is associated to form a molecule of sodium chloride is not apparent from the nature of the crystal structure.

Time need not be now occupied with the further discussion of the crystalline structure of simple substances; until the discovery of the X-ray effects thus briefly described, no direct method of determining those structures was available, and, in view of the paucity of the experimental data, only the possibilities of arrangement could be considered in the light of the Barlow-Pope mode of treatment. It will, however, be useful to review some of the results which accrue from this latter method of regarding the problem of crystal structure in general.

Taking the general standpoint, which is also in accordance with the Bragg results, that each component atom of a crystalline structure has a separate spacial existence, and premising that the atomic domains are close-packed in the assemblage in accordance with some particular type of equilibrium law, it becomes obvious that crystalline structure presents a volume problem. The law arrived at after a careful investigation of the subject—the so-called law of valency volumes—states that in a crystalline structure, the component atoms occupy domains approximately proportional in volume to the numbers representing the fundamental valencies of the elements concerned; the student of the subject of molecular volumes will hardly accept this conclusion without convincing evidence of its correctness—it indicates, for instance, that in crystalline potassium sulphate, if the atomic volume of potassium is taken as unity, those of sulphur and oxygen each have the value two. Many different lines of crystallographic argument converge, however, to this law, and, if the latter is in the end found to be incorrect, it at least represents something fundamental which still awaits enunciation in a more generally acceptable form. A few illustrative instances may be quoted.

If valency be a volume property, the relation should be revealed in the compositions of chemical substances, especially those of composite character. The sum of the valencies in potassium sulphate, K_2SO_4, is 12, and in ammonium sulphate, $(NH_4)_2SO_4$, 24, just twice the number; the two substances are so closely related that they crystallise together to form "solid solutions" (isomorphous mixtures. Similarly, in the alums, such as $K_2SO_4+Al_2(SO_4)_3+24H_2O$, the valencies are 12+36+96; the sum of the valencies of the water present, 96, is just twice that, 48, of those exhibited by the metallic sulphates. Similar curious numerical relationships occur in each of the well-defined series of double salts.

Again, if the valency volume law hold for two substances of different crystalline form, such as orthorhombic rubidium nitrate, $RbNO_3$, and rhombohedral sodium nitrate, $NaNO_3$, the metal, the nitrogen and the oxygen in each compound should have the respective atomic volumes, 1, 3, and 2. As the substances differ in density the absolute values of the atomic volumes of nitrogen and oxygen will differ in the two substances as examined in the same temperature; the ratios of the atomic volumes in either compound should, however, be as stated. Considering this conclusion in conjunction with the fact that these crystalline compounds represent symmetrically constructed assemblages, it would seem that the relative dimensions of the one crystal structure should be traceable in those of the other. Orthorhombic rubidium nitrate exhibits the axial ratios, $a:b:c=1{\cdot}7336:1:0{\cdot}7106$, three rectangular coordinates, a, b, and c, being used as the directions of reference; rhombohedral sodium nitrate exhibits $a:c=1:0{\cdot}8276$, the coordinates being three axes, a, making angles of 120° in one plane, and a fourth axis c, perpendicular to a. On converting the axial system of sodium nitrate into a simple set of rectangular axes similar to those used for rubidium nitrate, the value, $a:c=1:0{\cdot}8276$, becomes

$$a:b:c=1{\cdot}7320:1:0{\cdot}7151.$$

These values approximate very closely to those obtained by direct measurement of the orthorhombic rubidium salt. It seems difficult to avoid the conclusion that the two dissimilar crystalline structures are built up by the arrangement of layers or blocks of the same relative dimensions in two different ways, the molecule of sodium nitrate, $NaNO_3$, possessing practically the same relative dimensions as that of rubidium nitrate, $RbNO_3$; this, of course, is in disaccord with the classic conception of atomic volume, but agrees entirely with the valency volume law.

Another remarkable body of evidence is found in the interpretation of many morphotropic relationships between organic and inorganic substances which have been long recognised but have hitherto eluded interpretation. The description of one or two cases will make the bearing of the law of valency volumes clear in this connection.

d-Camphoric anhydride, $C_{10}H_{14}O_3$, and *d*-camphoric acid crystallised with acetone, $C_{10}H_{16}O_4$, 1/2 $(CH_3)_2CO$, both crystallise in the orthorhombic system and exhibit the axial ratios stated in the following Table II.:—

TABLE II.

	W	$a:b:c$	$x:y:z$
$C_{10}H_{14}O_3$	60	1·0011 : 1 : 1·7270	3·2654 : 3·2618 : 5·6331
$C_{10}H_{16}O_4$, 1/2 $(CH_3)_2CO$	74	1·2386 : 1 : 1·7172	4·0435 : 3·2646 : 5·0060

The ratio c/b is approximately the same in the two cases and general similarity exists between the two crystalline substances. It will be observed that the values of a/b are very nearly in the ratio of the sums of the valencies, W, making up the two molecular complexes, namely, $60:74=100:123$. This and similar cases may be more conveniently discussed with the aid of the so-called equivalence parameters; these are the edge lengths, x, y, and z, of a parallelepipedon of which the volume is W, the sum of the valencies in the molecule, and of which the linear and angular dimensions express the crystallographic axial ratios. Thus, for orthorhombic substance $xyz=W$, and $x:y:z=a:b:c$; the equivalence parameters of the two substances under discussion are given in the table, and it will be seen that whilst y and z are almost identical for the two, the z values differ considerably. This correspondence indicates clearly that in passing from camphoric anhydride to the acetone compound of the acid the mass added to the molecular complex, $H_2O+1/2(CH_3)_2CO$, occupies a volume proportional to the number of valency units which its contributes to the structure.

A very remarkable relation has been long recognised between the crystalline forms of the three minerals chondrodite, $Mg_3(SiO_4)_2$, $2Mg(F,OH)$, humite, $Mg_5(SiO_4)_3$, $2Mg(F,OH)$, and clinohumite, $Mg_7(SiO_4)_4$, $2Mg(F,OH)$; the crystalline forms are referable to three rectangular directions, a, b, and c, and the ratio $a:b$ is practically the same for all three minerals. The relationship is at once elucidated by the law of valency volumes in a simple manner. In the molecules of the three substances the sums of the valencies of the constituent atoms are respectively 34, 48, and 62; it follows from the law that these numbers are proportional to the relative volumes of the several molecules. The ratios, $a:b:c$, being known, the dimensions can be calculated of solid rectangular blocks having these volumes and having edge lengths proportional to the axial ratios, $a:b:c$. The equivalence parameters, x, y, and z, thus calculated are given in the following Table III.; the first observation of importance to be made is that the equivalence parameters, x and y, remain practically constant throughout the series of three minerals.

It will be seen that chondrodite and humite, and humite and clinohumite, differ in molecular composition by the quantity, $Mg_2(SiO_4)$; they form a series in which the increment of composition is $Mg_2(SiO_4)$. Subtracting this increment from the composition of chondrodite, the residue, $Mg_2(SiO_4)$, $2Mg(F,OH)$, is left. This is the composition of the mineral prolectite, and the increment, $Mg_2(SiO_4)$, is the composition of the mineral forsterite.

If the law of valency volumes be correct the equivalence parameters of forsterite should be the x and y of the first three minerals, and a value z which is the difference between the z values of chondrodite and humite, or of humite and clinohumite; further, prolectite should have x and y values identical with those of the other four minerals and a z value which is the difference of the z values of chondrodite and forsterite. It is thus possible to calculate the equivalence parameters of forsterite and prolectite without using data determined on these two minerals, and to compare the values so obtained with those calculated from the observed axial ratios of forsterite and prolectite. All the values referred to are given in Table III., and it will be obvious that the agreement between the calculated and the observed equivalence parameters is very close; as this agreement could not occur without the operation of the law of valency volumes, which was deduced from entirely different data, strong confirmation of the accuracy of the law is provided.

TABLE III.

Minerals	W	Axial Ratios		Equivalent Parameters			z/W
		$a : b :$	c	x	y	z	
Chondrodite ...	34	1·08630 : 1 :	3·14472	2·3367	2·1510	6·7644	0·19895
Humite ...	48	1·08021 : 1 :	4·40334	2·3343	2·1610	9·5155	0·19824
Clinohumite ...	62	1·08023 : 1 :	5·05883	2·3384	2·1646	12·2491	0·19756
Prolectite: observed	20	1·0803 : 1 :	1·8862	2·3130	2·1414	4·0385	0·19977
Prolectite: calculated	20	1·0818 : 1 :	1·8618	2·3365	2·1589	4·0211	0·19968
Forsterite: observed	14	0·9296 : 1 :	1·1714	2·3426	2·1778	2·7442	0·19601
Forsterite: calculated	14	0·9240 : 1	1·1741	2·3365	2·1589	2·7433	0·19585

The several illustrations of the operation of the law of valency volumes have been quoted in detail for the purpose of showing how difficult it is to avoid the conclusion that this deduction represents some physical reality. It may be traced in connection with quantitative data of other kinds; during the last few years it has been very successfully applied by Le Bas to the interpretation of the molecular volumes of liquid substances.

From what has been already said it will be seen that the great problem as to the relation between crystal structure and chemical constitution, of which the solution seems imminent, is a stereochemical one; assemblages must be built up in accordance with the principle of homogeneity and in some form of close-packing, in which each component atom of a chemical molecule is represented as the sole occupant of some specific solid area. The properties of these assemblages must also be in agreement with the crystallographic measurements and the X-ray photographs yielded by the substances represented.

A brief indication may be given of what has been already effected in this connection. The normal paraffin hydrocarbons of the general composition C_nH_{2n+2} consist of a chain of the composition $(CH_2)_n$, to each end of which one hydrogen atom is attached; in accordance with the principles already indicated, a close-packed assemblage of the empirical composition CH_2 can be constructed from carbon and hydrogen spheres of the respective volumes 4 and 1, of such a nature that it can be divided by planes into blocks, each made up of strings of the composition $(CH_2)_n$, or $.CH_2 . CH_2 . . . . CH_2 . CH_2$. At each plane of cleavage of the assemblage hydrogen spheres can be inserted in appropriate numbers so that close-packing is restored when the cleavage faces are brought together again; the assemblage will then have the composition $H . (CH_2)_n . H$, and may be geometrically partitioned into units each representing one molecular complex of a normal paraffin. It is noteworthy that these units exhibit the configurations indicated by the van 't Hoff-Le Bel conception for the normal paraffins. Other assemblages can be constructed which represent in a similar manner the secondary and tertiary paraffins, and all these assemblages are of one particular geometrical type, that which corresponds to the chemical behaviour characteristic of the paraffins. In these assemblages replacements may be effected so as to introduce new geometrical features of arrangement corresponding to the presence in the molecule of an ethylenic or an acetylenic bond, and thus other classes of hydrocarbons can be represented in accordance with the conception of close-packing; the process can be extended to the polymethylene and aromatic hydrocarbons and to their substitution derivatives, and throughout a close correspondence is observed between the numbers of isomerides possible, with their constitutions and configurations, and the experimental facts.

Many considerations indicate the fruitfulness of the mode of regarding organic substances just briefly sketched; one may be more particularly specified. An assemblage representative of benzene has been suggested which accords with the crystalline form and chemical properties of the hydrocarbon, and can be geometrically partitioned into units, each representing a single molecule. The equivalence parameters of the substance are

$$x : y : z = 3·101 : 3·480 : 2·780.$$

The dimension y is twice the diameter of a carbon sphere, and that of z slightly less than the sum of the diameters of a carbon and a hydrogen sphere. Now a dimension approximating closely to the z value for benzene can be found amongst the equivalence parameters of large numbers of aromatic compounds, indicating that in these crystalline substances the benzene complexes are stacked one upon the other so as to preserve the z dimension, but that the columns so formed are pushed apart in the derivatives to an extent sufficient to admit of the entrance, in close-packing, of the substituting radicles. A few cases of this kind were quoted by Barlow and myself, and many others were discovered by Jerusalem;[6] quite recently the subject has been subjected to a very thorough quantitative examination by Armstrong, Colgate, and Rodd.[7] The exhaustive nature of the experimental work of these latter authors and the care with which their conclusions are drawn leave little room for doubt as to the accuracy of their main contention, namely, that the crystallographic method affords material from which the stereochemical configurations of aromatic substances can be deduced.

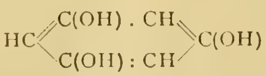
If cystallography is to be used as a tool in the service of stereochemistry in anything like the way which has been briefly sketched in this address, a number of important results should accrue. We have seen that in the structure assigned to rock-salt, each sodium atom is identically related to six chlorine atoms; only when the crystal is disintegrated by solution in water does the necessity arise for a choice to be made, the sodium atom then selecting one particular chlorine atom as a mate. Even then the sodium chloride molecule present in solution appears to spend the greater part of its time in dissociation, namely, in the act of changing its partner. There is thus in the theory of crystal structure something which bears a superficial relationship to electrolytic dissociation, and the further study of this aspect of the subject may be fruitful.

Again, the solid crystalline structures which we have attempted to build up present, as one essential feature, the property that they can be partitioned geometrically into unit cells, each composed of one molecule of the substance; thus, the rock-salt structure can be partitioned into cells each representing the molecule NaCl. In this instance, the partitioning can be performed

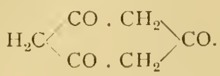
[6] Trans. Chem. Soc., 1909, 95, 1275.

[7] Trans. Chem. Soc., 1910, 97, 1578; Proc. Roy. Soc., A, 1912, 87, 204; 1913, 89, 292; 1914, 90, 111.

in a variety of ways corresponding to the allocation of one particular sodium atom to either of six chlorine atoms; the alternative modes of partitioning lead to the production of molecular units of identical configuration. In many cases, however, alternative methods of geometrically partitioning the assemblage representing the crystalline structure do not yield units of the same configuration; thus, the assemblage representing phloroglucinol can be geometrically partitioned in two distinct ways. Each of these gives a unit of the composition $C_6H_6O_3$, but the configuration of the unit of the one partitioning corresponds to the chemical structure of the 1 : 3 : 5-trihydroxybenzene,



whilst the other exhibits the structure of the symmetrical triketohexamethylene,



A new suggestion is thus made to the effect that tautomerism consists in the possibility of geometrically partitioning the close-packed assemblage in two or more alternative ways, each giving molecular units of the same composition but of different constitutions. The idea that in the occurrence of tautomerism some component atom wanders from one position to another in the molecule is thus rejected; the change in constitution arises from the transference of atoms as between two or more molecules. As the older conceptions of the mechanism of tautomerism do not provide a satisfactory explanation of the experimental facts, the suggestion now made is perhaps worthy of consideration.

The new line of work has many bearings upon the subject of chemical change; thus, the assemblage which is assigned to acetylene (or methylacetylene) is convertible, by symmetrical distortion, into that representing benzene (or the 1 : 3 : 5-trimethylbenzene, mesitylene. Further, the great change in chemical behaviour which accompanies many types of chemical substitution is possibly connected with the manner in which the actual atomic volumes are affected by the replacement; on converting benzene, in which the atomic volumes of carbon and hydrogen are as 4 : 1, into bromobenzene, a considerable increase in molecular volume occurs. The atomic volumes of carbon and hydrogen still, presumably, preserve the 4 : 1 ratio, and the volume appropriated by the entering bromine atom is approximately the same as that occupied by each hydrogen atom already present; the actual atomic volumes of carbon and hydrogen must thus be supposed to have increased during the production of bromobenzene. It can hardly be supposed that this fundamental volume change, even apart from a distortion of the aromatic ring arising from slight inequality of hydrogen and bromine atomic domains in the molecule, could occur without the exhibition of considerable differences in chemical properties as between benzene and bromobenzene.

Whatever view may be taken as to the accuracy of the conclusions concerning the relation between crystal structure and chemical constitution which are briefly discussed in the present address, no critic will be disposed to doubt that wide developments in chemical science will result from the cultivation of crystal study: it seems clear that any satisfactory theory of the solid state must be largely crystallographic in character. The chief hindrance to progress at present consists in the lack of chemists trained in modern crystallographic methods; in my own country the only school in which chemical students were trained in crystallography, dissociated from mineralogy, was founded by Dr. Henry E. Armstrong and Sir Henry A. Miers in 1886. After doing a vast amount of valuable educational work this school has recently been allowed to become extinct.

In a presidential address to the Mineralogical Society in 1888, Mr. Lazarus Fletcher remarked that "a knowledge of the elements of crystallography, including the mechanics of crystal measurements, ought to be made a *sine qua non* for a degree in chemistry at every university." Twenty-five years later we find that no European university has applied this principle, and in consequence the chemical crystallographer has the greatest difficulty in making himself intelligible to his purely chemical colleagues. May I, in concluding, express the hope that the colonial universities, less fettered by tradition than their older sisters, may lead in the work of placing the subject of crystal structure in its legitimate position as one of the most important branches of modern physical chemistry?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The Principal wishes it to be known that the University will do what it can to safeguard the academic interests of undergraduates on military duty. In relation to attendance on courses of instruction, to duration of study, to periods of notice required, etc., account will be taken of a student's absence on military duty to ensure, if possible, that his graduation shall not be unduly delayed.

THE authorities of the Royal Agricultural College, Cirencester, wish it to be known that every endeavour will be made to prevent students who are undertaking army or other patriotic work from being thereby penalised as regards their courses of study.

THE Vice-Chancellor of the University of Liverpool states that although the Council and Senate have not met since the declaration of war, it may be assumed (1) that the University courses will begin on the appointed day; (2) that in due time everything will be done that can be done to safeguard the interests of members of the staff and of students who have offered themselves for national service at home or abroad. It is also announced that at Durham University the term will begin as usual in October, and that no member of the Durham Colleges will suffer any academic disability by reason of absence on any form of national service.

THE fifty-fifth annual report of the Cooper Union for the Advancement of Science and Art has been received from New York. The union governs and finances many departments of higher education, and in the report its director gives full particulars of the work done during the year ending June, 1914, and directs special attention to the development of the technical school. We notice the resignation of Prof. Robert Spice, after twenty-five years' service in Cooper Union as professor of chemistry and head of the department of chemistry. Since 1900 Prof. Spice has devoted the whole of his time to the Cooper Union; beginning with some twenty students the attendance has steadily increased until now the limits of the capacity of his department have been reached.

THE Vice-Chancellor of the University of Wales has written to the Press to say that he is prepared to undertake that the University will arrange that, in the case of students who entered the University in 1911, the coming session shall not be reckoned as the last of the four years beyond which honours in the B.A. or B.Sc. degree cannot be obtained, so that they may complete honours schemes in the session 1915–16 under the same conditions under which they would have completed them in the coming session. He says it will be understood that, as pursuance of qualifying courses is essential for initial degrees, a year of absence cannot be reckoned as a year of the qualifying period; but, subject to this proviso, he has no doubt that the University will be anxious to consider cases of disability arising, other than the one above provided for, with the view of making special arrangements for their relief.

THE former circular on geometry, issued five years ago by the Board of Education, has exercised a marked and unquestionably beneficial influence on elementary education. We do not know of any geometrical text-book, published since that date, which has not taken account of it, and we have frequently directed attention to it in these columns. That circular is now out of print, and the Board has, therefore, drawn up the present memorandum (*Memorandum on the Teaching of Geometry in Secondary Schools*) which covers the same ground, slightly more elaborately. Now that it is generally recognised that Euclid's postulates are far from being exhaustive, and that any philosophically complete set involves abstract considerations, wholly unsuitable for immature minds, there seems to be a growing consensus of opinion in favour of widening the basis of deduction, and including in it such spatial ideas as the ordinary boy (when he appreciates the significance of the statements made) regards as obvious. A proof which is not the cause of intellectual conviction, if only because belief exists independently, stands *ipso facto* condemned. The basis which has been suggested includes the fundamental properties of angles at a point, parallelism, and congruence. This provides a perfectly intelligible system of postulates and requires nothing which will present any difficulty to a boy who is capable of geometrical work of any kind, if the facts are presented to him in a satisfactory manner; and it enables him to proceed to apply deductive methods to the establishing of properties of which he realises the need of proof, thus arousing in him that interest which springs from a recognition of the utility of his work.

BOOKS RECEIVED.

The Vaccination Question in the Light of Modern Experience. By Dr. C. K. Millard. Pp. xvi+244+10 plates. (London: H. K. Lewis.) 6*s*. net.

Suggestions for a Course in Climatology in Correlation with Geography. By W. E. Whitehouse. Pp. 31. (Aberystwyth: University College.) 1*s*.

Report on Scottish Ornithology in 1913, including Migration. By E. V. Baxter and L. J. Rintoul. Pp. 96. (Edinburgh: Oliver and Boyd.) 1*s*. 6*d*. net.

General Report on the Operations of the Survey of India during the Survey Year 1912–13. Pp. x+43+maps. (Calcutta: Survey of India.) 3*s*.

Memoirs of the Geological Survey of India. Vol. xli. Part 2: On the Geology and Coal Resources of Korea State, Central Provinces. By Dr. L. L. Fermor. Pp. iv+148–245. Vol. xlii. Part 1: The Burma Earthquakes of May, 1912. By J. C. Brawn. Pp. vi+147. (Calcutta: Geological Survey of India; London: Kegan Paul and Co., Ltd.) 4*s*. each.

Annals of the South African Museum. Vol. x.: Descriptions of New Species of Lepidoptera Heterocera in the South African Museum. By W. Warren. Pp. 467–510+2 plates. (London: West, Newman and Co.) 6*s*.

Ninth Annual Report of the Meteorological Committee, for the year ended March 31, 1914. Pp. 69. (London: Wyman and Sons, Ltd.) 4*d*.

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