Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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

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Science in the Civil Service.

TWENTY years ago there were very few scientific workers in the Civil Service; only one or two Departments existed where a knowledge of science was a qualification for employment, and the higher Civil Service contained few men who could claim even a nodding acquaintance with scientific thought. The rapid growth of the public Services within the last fifteen years, the assimilation of public utility companies into the State system, the creation of entirely new Departments, and the realisation forced upon Ministers by the war of the necessity for scientific research in the nation's interest, have resulted in the employment of thousands of scientific and technical workers. Many of those engaged temporarily during the war have returned to the universities or other institutions from which they were recruited, but a large number remain and have been absorbed by various State establishments. The position of such workers demands our earnest attention. Prejudice dies hard, and there are still many men in high administrative positions in the Civil Service who hold science in contempt, and this feeling is reflected in their attitude towards scientific workers in their Departments.

It is true, perhaps, that there is something incompatible between science and the Civil Service as it exists. There is a fierce egoism in science which combats the merest semblance of submission to the rigid tyranny of the administrative system. The true scientific worker is impatient of the delay which is the direct outcome of existing departmental methods. He wants to get the results of his labours to the outside waiting world immediately; he is restrained daily by the exasperating regulations which prevent him from doing so. He is for ever reacting against the repressive influence of his environment and the irritating interference of the lay official disciplined to the system.

However, scientific workers have been attracted to the Civil Service in increasing numbers not so much by the emoluments or the security of tenure —the primary considerations of unprogressive minds—as by the opportunities afforded by Government service for the continuation of their researches, which would otherwise have to be abandoned to take up teaching or commercial posts. Some new Departments are the direct outcome of their labours. But gradually their functions are being usurped by the adept place-hunters in the administration, and already some of the ablest men of science, who have given signal proof of their ability to run their own Departments satisfactorily, have been forced to relinquish administrative control to the lay officer. We can think of only two remaining scientific heads of Departments who rank with permanent assistant Secretaries of

State—only two, that is, who can be assured that their schemes will not be mutilated by a non-scientific officer before going through the permanent Secretary to the appropriate Minister. The semi-official apology for this remarkable state of affairs is somewhat disingenuous. It is urged that the administrative machine is so complex that only those with long experience are competent to work it. If this be the true explanation of the subordination of the man of science to the lay official, it is high time the machinery of our Government Departments was overhauled. Ministers responsible for scientific Departments should realise that there is a growing class-consciousness among the younger men of science, and real resentment felt against the intrusion of lay officials into their proper sphere of activities. Such intrusion means duplication of work. It is worthy of note that in one Department where the lay element has been subordinated to the scientific staff a pre-war staff of more than a hundred has been reduced to eighty-two, although the work of the Department has greatly increased in the meantime.

The present system presents yet a further fault which must be remedied. The administrative head of a Department, the lay official, has authority to select the heads of scientific Departments under his immediate control. Being without the necessary qualification to judge of the scientific experience of a scientific worker, it follows that he must, to a large extent, rely upon the judgment of the retiring officer or of other scientific workers of his own choosing. In neither case does it follow that the best man available is chosen. We suggest that some machinery should be put into motion whereby the State could be reasonably assured of the high calibre of its scientific officers. Their selection might, for example, be entrusted to *ad hoc* committees of scientific experts appointed by outside scientific bodies at the request of the Government.

An inter-departmental comparison of the grading and salary scales of scientific workers in the Civil Service would reveal glaring anomalies, but it would occupy too much space in NATURE. In no case do the status, pay, and prospects of promotion of scientific workers compare favourably with those which obtain in the higher clerical grades. Leaving out of consideration the conditions of service of medical men, the scheme lately adopted for scientific workers in the Fisheries Division of the Ministry of Agriculture and Fisheries is the most favourable in the Service. A comparison between this scheme and that in force for the higher clerical grades is given below :—

	Higher Division Clerks. (Administrative Class.)		Salary. £ £		Scientific Workers.	Salary. £ £
Grade	I.	1 post	1000–1200	...	1 post	1000
,,	II.	2 posts	700– 900	...	2 posts	650–750
,,	III.	4 ,,	500– 700	...	5 ,,	450–650
,,	IV.	4 ,,	200– 500	..	13 ,,	200–450

(All the above posts carry with them Civil Service bonuses in force.)

Such disparities of pay and prospects must react unfavourably against the recruitment of the best scientific workers to the ranks of Government officers. The best men will be attracted to the administrative class and be lost to science. Last year the Civil Service National Whitley Council published a report on the organisation of the Civil Service in which a comprehensive scheme was put forward for the clerical classes. After considerable delay a technical committee of the same council has been entrusted with the task of preparing a scheme for the scientific and technical classes. In the meantime the issue has been prejudicially affected by the varying schemes put forward by different Departments. There is no apparent reason for the inordinate delay in setting up the technical committee. It would have been more satisfactory to deal with all classes of Civil Servants in one report, like that on the United States Civil Service described in last week's issue of NATURE.

A Great Giver.

Autobiography of Andrew Carnegie. Pp. xii + 385. (London : Constable and Co., Ltd., 1920.) 25*s*. net.

THE life-histories of remarkable men always have interest and value. Few are more fascinating than that of Andrew Carnegie, who began his business career as a telegraph messenger boy at two and a half dollars a week, and step by step, through many trials and triumphs, became the great steel-master, built up a colossal industry, amassed an enormous fortune, and then deliberately and systematically gave away the whole of it for the enlightenment and betterment of mankind. No doubt the element of chance has some part in such great success as that of Carnegie. But it is only a subordinate part. This autobiography enables us to see clearly enough that it was "character" inborn and nurtured by parents—sturdy and high-principled, though brought by the vicissitudes of business to great poverty, even to actual hunger—which determined Carnegie's career. Character made him

courageously and honestly avail himself of the opportunities which "chance" placed to his hand.

Andrew Carnegie's childhood was influenced, as he tells us, by his birthplace, Dumfermline, the burial-place of King Robert the Bruce, with its abbey-church, palace, and glen—"perhaps the most radical town in the kingdom." From his uncles Bailie Morrison and George Lauder he learned much of Wallace, Bruce, and Burns, and he avows "there was then and there created in me a vein of Scottish prejudice or patriotism which will cease to exist only with life." He always kept Burns's philosophy of life before him, and as a schoolboy, when tempted to do a weak or selfish thing, would ask himself: "What would Wallace have done?" and braced himself to the braver course. His father's occupation as a hand-weaver having been superseded by the competition of large factories, the family—father, mother, and two sons, Andrew, aged twelve, and Thomas, aged four—emigrated to Pittsburg (Allegheny City), in the United States, where they had friends and hard-working relatives.

In the autobiography now published Andrew Carnegie tells his own story, not as one posturing before the public, but as in the midst of his own people and friends, tried and true, to whom he can speak with the utmost freedom. It is impossible to epitomise such a narrative. Its charm lies in the record of friendships and in personal touches, in the statement of guiding faith and principle, and of the worldly wisdom of a generous and worthy spirit which accompanies the detailed story of the steps by which the author rose. From being a messenger boy he became a telegraph operator, then a divisional superintendent of the Pennsylvania Railroad. He invested his first savings in the building of sleeping-cars and went on to the organising of rail-making and locomotive works and the formation of a company to build iron bridges, for which he also started the making of pig-iron. And so we come, in 1868, when Carnegie was thirty-three years old, to his great contracts in bridge-building and his negotiations with the bankers of New York and London, his ready command of capital, and the final concentration of all his energies upon the introduction into Pittsburg of the Bessemer steel process and the organisation of the Carnegie Steel Co.

In December, 1868, Carnegie wrote a memorandum which has great interest to-day. It is dated from the St. Nicholas Hotel, New York. He writes:

"Thirty-three and an income of 50,000 dollars per annum. By this time two years I can so arrange all my business as to secure at least 50,000 dollars per annum. Beyond this never earn—make no effort to increase fortune, but spend the surplus each year for benevolent purposes. Settle in Oxford and get a thorough education, making the acquaintance of literary men. . . . Settle in London. . . . Man must have an idol—the amassing of wealth is one of the worst species of idolatry. . . . I will resign business at thirty-five, but during the ensuing two years I wish to spend the afternoons in receiving instruction and in reading systematically."

Happily (or perhaps unhappily) for him, he did not carry out this programme. For another thirty-two years he was the head of the great business which grew and flourished marvellously in his hands. During that period he had more leisure—he travelled round the world, he spent summer holidays in Great Britain, and made the close friendship of such men as Matthew Arnold, Herbert Spencer, and many others prominent in literature or politics. In 1886, when he was fifty-one, both his mother and his brother died, and in the following year he married Miss Whitfield, of whom he writes (twenty years later) in 1906: "I cannot imagine myself going through these twenty years without her. Nor can I endure the thought of living after her."

Mr. Carnegie tells us in this autobiography that in 1901 the profits of his firm had reached forty millions of dollars per annum, and that seventy millions might have been earned in the year when he and his partners were informed by Mr. Pierpont Morgan, the banker, that if they wished to retire from business he thought he could arrange it. The Carnegie Steel Co. was bought by Mr. Morgan at the price which both he and Carnegie considered fair. We are not told in this book exactly what it was, but it was probably somewhere about one hundred and fifty million pounds, of which a smaller part went to Mr. Schwab and his partners, and the rest to Carnegie.

Andrew Carnegie had found great pleasure in giving pecuniary help to various public purposes during his fifty and more years of money-making. He now, at the age of sixty-six, set to work deliberately to give away his vast fortune (after amply providing for his wife and daughter) in such a way as to make it a source of betterment to his fellow-men. The present writer knew him at this period, and visited him at his place in Scotland, Skibo Castle. He was a kindly and unselfish host, taking a real pleasure in literature, and enjoying both golf and salmon-fishing. He was devoted to church music, and kept an accomplished musician to play the fine organ built in the hall of Skibo. He knew nothing of pictures

or of science. There is no doubt that he devoted an immense amount of trouble and consideration to devising methods of bestowing his endowments which should be really beneficial and not either futile or pauperising.

There are many people who, through ignorance and a low estimate of human motive, sneer at Carnegie's "free libraries," and foolishly regard his generous gifts as mere vanity and self-advertisement. Those who knew him, and, indeed, all who examine the record of his various benefactions, are led to a different conclusion—namely, that he carried out in his later years the generous purpose of his early life, and aimed at employing his wealth for the good of the community, with some kindly partiality towards the men who had worked in his employ and those associated with his native place. We cannot give here the complete list and amounts of his benefactions, but to the Carnegie Corporation of New York, "to promote the advancement and diffusion of knowledge by aiding institutions of higher learning and scientific research," he gave 25 million pounds, and it is not yet known what further sum it may receive as his residuary legatee. To the relief fund for men in his mills he gave one million pounds; to establish, in the United States, a pension fund for aged university professors he gave three million pounds, and a million pounds to pay the fees of poor students in Scotch universities; and another million to improve the universities. To nearly three thousand towns (many in Great Britain) Carnegie gave library buildings at a cost of fifteen million pounds. To establish the beautiful museum, library, and picture gallery at Pittsburg, he paid more than five million pounds. Including his hero fund, his Peace Palace at The Hague, and many minor gifts, the Carnegie benefactions, all told, amount, according to the authoritative statement of the editor of this autobiography, to something more than seventy million pounds sterling (350 million dollars)—"a huge sum," as the editor remarks, "to have been brought together and then distributed (in his lifetime) by one man."

The gift in making which Mr. Carnegie tells us he had a greater pleasure than he derived from any other was that of Pittencrieff Park and Glen, together with King Malcolm's tower and St. Margaret's shrine—the paradise of his childhood—presented by him to his native city, Dumfermline. The final chapter of the book tells of Carnegie's visit to the Emperor William, and the bitter disappointment of the old man when, in 1914, he found his faith in the Emperor as a man of peace misplaced.

The bare facts which we have mentioned in this notice of Andrew Carnegie's autobiography are transformed in their narration by the man himself into a most engaging personal story, replete with revelations of worldly wisdom, generous and upright character, and tender feeling. It is, indeed, well worth reading. One of America's greatest men—Elihu Root—in 1920 said of Carnegie at a meeting held in memory of his life and work:

"He belonged to that great race of nation-builders who have made the development of America the wonder of the world. He was the kindliest man I ever knew. Wealth had brought him no hardening of the heart, nor made him forget the dreams of his youth. Kindly, affectionate, charitable in his judgments, unrestrained in his sympathies, noble in his impulses, I wish that all the people who think of him as a rich man giving away money he did not need could know of the hundreds of kindly things he did unknown to the world."

E. RAY LANKESTER.

Mathematical Papers of Huygens.

Œuvres Complètes de Christiaan Huygens. Tome Quatorzième. Calcul des Probabilités. Travaux de Mathématiques Pures; 1655–1666. Pp. v+557. (La Haye: Martinus Nijhoff. 1920.)

THIS volume contains Huygens's celebrated essay, "De ratiociniis in ludo aleæ," and various minor mathematical papers of his earlier years. The theory of probability was founded in 1654, when a gambler who was interested in mathematics proposed to Pascal some problems connected with games of chance. Pascal corresponded with Fermat about one of these, the "problem of points," to which he attached the greatest importance. Two players of equal skill want each a certain number of points to win; if they stop their game before it is finished, how should the stakes be divided between them? Pascal and Fermat came to the same result, but gave different proofs. In the following year Huygens was in Paris and heard of this, but he neither met Pascal or Fermat, nor received any information as to their methods.

On his return home he lost no time in preparing his treatise on games of chance, which was published in Latin in 1657 as an Appendix to van Schooten's "Mathematical Exercises," and three years later in the original Dutch. The treatise contains fourteen propositions. The first three define the expectation of a player who has p chances of gaining a sum a and q chances of gaining b, as $(pa+qb)/(p+q)$. The six next pro-

positions discuss simple cases of the problem of points when there are two or three players; the method is similar to that of Pascal. The remaining five propositions deal with questions relating to dice, after which Huygens gives five exercises without demonstrations, which are left to the reader. Three of these had been proposed to Huygens by Pascal and Fermat. Their solution afterwards occupied Hudde, De Moivre, James Bernoulli, and others, and the generalisations to which they led had an important influence on the development of the theory of probability.

Several of the most valuable works of Huygens were published long after they were written, whereby he lost the priority of various important discoveries. Thanks to van Schooten, the treatise on probability was promptly issued, and it remained for more than fifty years the only introduction to the theory. Two English translations appeared, and James Bernoulli reprinted it in his "Ars conjectandi." Huygens continued up to 1688 to occupy himself occasionally with questions arising out of his treatise, and the five exercises at the end of it. He never published any of his notes, but they are now printed in the form of nine appendices. The same methods are followed in them as in the treatise.

The remaining two-thirds of the volume contain various mathematical studies from the years 1655 to 1666. Among these are some dealing with the theory of numbers, and particularly with the equation known as Pell's, $ax^2+1=y^2$, where a is an integer which is not a square. Other notes discuss problems of rectification or quadrature, or examine the properties of the cycloid and other curves. Many of the results thus found were published by Huygens in 1673 in his "Horologium oscillatorium," but without proofs and without any clue to the way in which they were found. The studies now printed for the first time thus form a valuable supplement to that work and throw much light on the methods he employed to discover the results announced in it. A similar case is the "rule for finding logarithms" which Huygens communicated to the Paris Academy in 1666 without explanation or proof, and which was first found in the Archives of the Academy and published by Bertrand in 1868. It was suggested by Bertrand that Huygens must have known and used the series $\log(1+x)=x-\frac{1}{2}x^2+\frac{1}{3}x^3-\ldots$ We see now that this was not the case, but that Huygens used a method founded on an approximate quadrature of the hyperbola deduced from a theorem which he had published in 1651.

Huygens also contributed to the solution of one of the burning questions of the day, the drawing of tangents to algebraic curves. His notes on the subject are given in the present volume. He found, however, when the third volume of Descartes's Letters came out in 1667, that he had been anticipated. This was fully acknowledged by Huygens in a paper published by the Academy in 1693, in which the priority of Sluse and Hudde is recognised. The papers communicated by Huygens to the Paris Academy, and everything connected with them, are to be published in a later volume of the "Œuvres complètes."

J. L. E. D.

Four Aspects of Parenthood.

The Control of Parenthood. By Prof. J. Arthur Thomson and Others. With an introduction by the Bishop of Birmingham. Edited by Dr. James Marchant. Pp. xi+203. (London and New York: G. P. Putnam's Sons, 1920.) 7*s.* 6*d.* net.

DURING the past seven years the National Birth-rate Commission has been sitting, and it has published two reports, one in 1916, entitled "The Declining Birth-rate: its Causes and Effects," and the other, called "Problems of Population and Parenthood," in 1920. Smaller volumes have already sprung up around these large reports, and they have dealt with certain aspects or phases of the great general question of the falling birth-rate and all it may involve. One of these smaller books is the work before us; it contains short essays on four aspects of the subject—the biological, the economic, the social and religious, and the Imperial and racial; there is an introduction by the Bishop of Birmingham, and the whole is edited by Dr. James Marchant, who is the secretary of the National Birth-rate Commission itself.

The biological aspects are considered by Prof. J. Arthur Thomson, of Aberdeen University, whose fascinating works on natural history and sex are an assurance that facts will be found here clearly and attractively stated; and Prof. Leonard Hill, whose research work in physiology gives him every right to speak with authority upon such a subject as the present. Dean Inge and Mr. Harold Cox write on the economic aspects; Dr. Mary Scharlieb, the Rev. F. B. Meyer, and Principal A. E. Garvie represent the social and religious aspects; and Sir Rider Haggard, the novelist, and Marie Carmichael Stopes, the doctor of science and philosophy, deal with the Imperial and racial side of the matter. All the birds in this little nest of authors are not, however, singing in tune, and, in

particular, Dr. Mary Scharlieb, the doctor of medicine, differs in emphatic terms from Dr. Marie Stopes, the doctor of science and philosophy.

The second, third, and fourth aspects of the subject of the control of parenthood scarcely fall to be reviewed in a journal like NATURE, but the first may fairly claim notice. Prof. Hill's contribution is rather too closely packed with facts regarding embryology, pregnancy, housing, and food to be grasped easily in its significance; but its author is sturdily opposed to artificial means of preventing conception which "demand a premeditated act in what should be a natural function and disturbs the normality of the sexual act." Such a use of preventives tells also far more against the woman than the man. Prof. Hill sees the risks, the physiological risks as well as the social, of the only child. His solution of the problem of keeping down the vigour of sexual desire is "a wisely regulated diet, *plus* hard physical exercise and occupation."

Prof. J. Arthur Thomson, from the point of view of biology, writes with all his accustomed picturesqueness of imagery, but the brilliancy of his phrasing is somewhat of a danger, and may even constitute a sort of verbal camouflage, a risk which he himself seems to recognise when in his closing paragraph he says: "We must not, however, look at things too biologically . . . we are mind-and-body creatures, and the greatest thing in human life is love." After enumerating all the evils which may arise from birth control, he directs attention to the fact that the good side of the reduction of the birth-rate deserves more consideration than it usually receives. It may improve the health of both mothers and children, give quality for quantity, render life less anxious and earlier marriage more practicable, work against war, make woman's position more independent, and so forth. His contrast between the keeping up of numbers by the fertility or spawning method, with its unlimited production of lives the majority of which almost immediately cease, and by what he finely designates "economised reproduction associated with increased parental care," is absolutely conclusive in favour of the latter plan.

The spawning solution among the lower animals themselves is less effective in the long run than that which Peripatus adopted—viz. the giving birth to a few miniature adults ready at once to fend for themselves. "The tapeworm, with its degenerate body and drifting life of ease, has its millions of embryos; the golden eagle, with its differentiated body and controlled life, has two eaglets at a time." Yet it is not securely known that high individuation directly lessens fertility, for whilst some of the greatest men were childless a fair list of famous fathers can be made out. After all, the strictly scientific or the rigidly biological aspect of human reproduction refuses to be dissociated from the other ways of looking at things; and Prof. Thomson closes with words which have weight: "If we lose the adventurousness of early marriage on meagre material resources, and the delight of having children while we are young enough to sympathise with them, we are missing some of the fragrant flowers of life."

Our Bookshelf.

Recueil de l'Institut Botanique Léo Errera (Université de Bruxelles). Publié par L. Errera. Tome iv. Pp. xi+653+plates. (Brussels: Maurice Lamertin, 1920.) 50 francs.

THIS ponderous volume contains a selection of papers published in various scientific journals from 1885 to 1900 by the late Léo Errera and other Belgian botanists. There are a few short communications by Errera at the beginning of the volume of a general nature, such as those on the law of the conservation of life, spontaneous generation, and the mechanism of sleep. The volume is mainly a collection of papers on plant cytology and on the physiology of organisms of simple structure. Workers specially interested in these branches will appreciate the advantage of associating in one volume a number of papers scattered through many different journals, but as all these journals are fairly accessible the production of a great mass of reprints may seem somewhat extravagant in view of the difficulties attending scientific publication at the present time.

The volume contains thirty-two papers in all; nineteen, mostly brief, are by Errera, including one in which the inheritance of acquired characters in a mould-fungus (Aspergillus) is maintained; others deal with protoplasmic movement, the ascent of sap, and an apparatus to demonstrate the mechanism of stomates. Communications by E. Laurent and G. Bullot deal with the physiology of growth and curvature of the fungus Phycomyces; and Jean Massart discusses the sensibility to various external influences of unicellular organisms under several headings. The irritability of Noctiluca he describes as analogous to that of the Sensitive Plant, the essential difference lying only in the manner of the reaction. The longest paper is by E. de Wildeman (published in 1893) on the formation of the dividing wall in cells; the subjects of study were mainly species of mosses and brown and red seaweeds.

Manuel de Topométrie. Opérations sur le Terrain et Calculs. By Jules Baillaud. Pp. vii+222. (Paris: H. Dunod, 1920.) 13 francs.

IN this book Capt. Baillaud sets down his war experience in the preparation of the plans neces-

sary for artillery work, gathered during two years spent as Chef de Brigade Topographique. No claim is made to the production of a complete text-book of surveying; the author's limited experience would preclude that; and, as will be naturally understood, the practised surveyor has little to learn from this volume. The only point where it may possibly be of service in supplementation to more complete treatises is in the discussion given of the problem of resection, particularly of resection from more than three points, a problem somewhat neglected by English writers. A fervent claim is made to the superiority of the centesimal division of the quadrant, which, it is held, offers practical advantages, such that, once used, it is hard to understand how its merits can be doubted; "one returns with difficulty to the sexagesimal division." However this may be, the subject is now beyond discussion, there not being the remotest chance of the use of the centesimal system spreading outside the pale of the Service géographique de l'Armée. Even admitting that there are some gains in facility of computation, we think these dearly purchased at the cost of this isolation.

A recommendation is made that when taking out the number corresponding to a given logarithm a table of antilogs should be used, and it is regretted that no such table, extending to more than four decimal places, has been published. This must be read as meaning published in France. Such tables are common here, and an excellent little set of five-figure tables, including antilogs, is (or was?) procurable at the modest price of sixpence, while Filipowski's seven-figure tables are well known. They are not more generally employed solely because computers find that, on the whole, the use of the simple log table is preferable. E. H. H.

Basic Slags: Their Production and Utilisation in Agriculture. (Reprinted from the Transactions of the Faraday Society, vol. xvi., part ii., 1920.) Pp. 259–335. (London: The Faraday Society, n.d.) 7*s.* 6*d.*

THIS full report of the discussion organised by the Faraday Society last March on the utilisation of basic slag in agriculture forms a convenient little booklet which agricultural lecturers and experts will find of considerable value.

The necessity for the discussion arose out of the change in the manufacture of steel which began before the war, but has proceeded at an increasing rate in the past few years. In consequence, agriculturists no longer obtain the slag to which they have been accustomed, and which was used in the classical experiments that have passed into agricultural tradition; they obtain instead something completely different under, however, the same name. An account of the discussion was reported in NATURE of April 8, 1920 (p. 183).

From the agricultural point of view there is an interesting account of the field trials with the new slags, which suggests for them a better value than was first expected from the chemical analysis. On the works side the report does not make very hopeful reading; no easy way could be found for increasing the phosphorus content of the slag, apart from the simple addition of mineral phosphates, which would be quite unnecessary.

The meeting was useful, and the publication of the papers will prove even more so, as it will enable a wider circle to appreciate the present position of the basic slag problem. It is gratifying to know that, as the direct outcome of the discussion, the Ministry of Agriculture set up a Committee of steel-makers and agriculturists to go into the question of the improvement of basic slag, and to report on any action that could be taken. The Committee is presided over by Dr. E. J. Russell, of the Rothamsted Experimental Station, and is understood to be pursuing its inquiries with a view to an early report. The Faraday Society is to be congratulated on the success of its efforts.

Les Variations et leur Hérédité chez les Mollusques. By Paul Pelseneer. (Mémoires de l'Académie Royale de Belgique, Classe des Sciences, Collection in-8°. Série II., tom. v.) Pp. 826; 286 illustrations in the text. (Brussels, 1920.)

CUT off from the sea, his library, and his laboratory at Ghent, that doyen of malacologists, Dr. Paul Pelseneer, during the German occupation of Belgium, fell back on his note-books and such material as lay to his hand, and has put together a fine volume that will be a work of reference for practically all time.

The variations observable in the Mollusca have never hitherto been systematically studied as a whole. Dr. Pelseneer now takes them up seriatim as they occur in the shell, in the external features of the animal, and in the various internal organs and their systems (circulatory, respiratory, nervous, etc.), plentifully quoting original observations in addition to his own, and illustrating the whole with reproduced and new figures. He classes these variations and discusses their interrelationships, individual and specific, in different organs, their cause, especially when due to environment, and finally their heredity.

It is impossible within the limits of a short notice to summarise even the author's conclusions: the work itself must be consulted. When, however, he states that there is no example in the Mollusca of preadaptation, we venture to think he must have overlooked the case of the myophore in Velates, and of the dorsal depression in the shell of the young Nautilus, which later on receives the ventral curve of the preceding whorl, as pointed out by Hyatt in his "Phylogeny of an Acquired Characteristic."

The book is touchingly dedicated "A la mémoire de mes Compatriotes victimes de l'agression Allemande (1914–1918)." B. B. WOODWARD.

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.*]

Amplifying the Optophone.

IT may be of interest to record some experiments that I have recently been making on the application of a thermionic amplifier to increase the volume of the sounds produced by Dr. Fournier d'Albe's very wonderful optophone so as to render these sounds audible to everyone in a room without the necessity of each listener being furnished with a separate telephone receiver.

The experiments were carried out at the instance of Mr. J. M. McCarthey, who is teaching blind soldiers to read with this instrument, and who asked me whether it would not be possible to magnify the sounds sufficiently to enable a class of a dozen or more to hear them simultaneously.

The Fournier d'Albe optophone instrument employed was one of the improved type designed and manufactured by Messrs. Barr and Stroud, and the amplifier I found to work best out of several I tried was an audio-frequency one with three "R" valves, transformer-coupled, of the French military type. This was used with a Brown loud-speaking telephone with considerable success.

In Mr. McCarthey's opinion, and so far as a person such as myself, who has no experience with the optophone, could judge, the best results were obtained when the optophone was arranged for what is technically known as "black sounding," when the white paper is represented by silence and notes are sounded as the beam of light passes over the black letters.

I have very little doubt that still better results could be obtained with an amplifier specially designed for the purpose. Further experiment is desirable in order to obtain the best results, but, so far, what has been accomplished is quite encouraging.

A. A. CAMPBELL SWINTON.
66 Victoria Street, London, S.W.1,
February 25.

Molecular and Cosmical Magnetism.

DR. CHAPMAN'S important letter (NATURE, November 25, 1920) bases a theory of cosmical magnetism on the presence of gyroscopic magnetic elements proved to exist in ferro-magnetic substances by my investigations on magnetisation by rotation. But he considers my fundamental theory to require serious modification. As I understand his letter, however, his theory is identical with mine (see *Science*, vol. xlviii., p. 304, 1918, and references) except as to paramagnetic and diamagnetic bodies. He has, I think, confused my treatments of magnetic intensity and intensity of magnetisation.

While in my papers electron rings or orbits have been assumed, the fundamental theory is essentially the same if ring electrons or magnetons of other types, preferable for Dr. Chapman's purpose, are assumed instead; and I have referred to this equivalence before the Physical Society and elsewhere.

The gist of the theory is this: A magneton or electron orbit, being a gyroscope, tends to take an orientation with the direction of its revolution coincident with that of any rotation impressed upon it. Being a magnet, it also tends to set with its axis parallel to an impressed magnetic intensity. Ultimate coincidence in either case may be prevented by extraneous forcives. But, in given circumstances, whatever the forcive towards alignment, and whatever alignment of the magneton is produced by a magnetic intensity, H will be produced by rotation about the direction of the intensity with velocity $\Omega = H/R$, where R is the ratio of the angular momentum of the magneton to its magnetic moment. The general idea has been applied to cosmical magnetism by Schuster (1912), by Einstein and by de Haas (1915), and by myself (1909 and 1915), though not with Dr. Chapman's detail.

If all the magnetons within a body are alike, rotating it at velocity Ω will produce the same magnetisation as would be produced by applying a uniform magnetic field of strength $H = R\Omega$.

For weak fields the ferro-magnetic bodies rotated all receive intensities of magnetisation proportional to the intensities of the fields applied, and are thus *magnetised* by rotation proportionally to velocity. This proportionality exists only for elastic displacements to which Dr. Chapman refers (and to which I have referred, comparing the molecular forces to those due to springs).

If the magnetons in a body are of two kinds, positive and negative, with constants R_1 and R_2, rotating the body will have the same effect as if a magnetic intensity $H_1 = R_1\Omega$ were applied to the positive magnetons and an intensity $H_2 = R_2\Omega$ were applied to the negative magnetons. If the effect on the negative magnetons is preponderant, the rotation will thus produce an intensity of magnetisation in the direction of H_2, but of magnitude less than that which would be produced by the intensity $R_2\Omega$ if all the magnetons were negative.

When the displacements are not elastic my theory gives results analogous to those of Voigt for a swarm of magnetons in an ordinary magnetic field. If there are N similar magnetons per unit volume, if the rotations are damped only about the axes perpendicular to the magnetic axis, and if the effects of collisions and the molecular field are negligible, all the magnetons, even in the weakest magnetic field of strength H, will ultimately become oriented with their axes in the direction of the field. In this case, if C and U denote the moment of inertia and initial (permanent and undamped) angular velocity about the magnetic axis of a magneton, the intensity of magnetisation will be

$$I = NC/R.(U - H/R).$$

The first and principal term is entirely independent of H. The orientation is produced by the field, but only the time taken to arrive at the steady state is affected by its magnitude. If collisions are not absent, or the molecular field becomes appreciable, the intensity of magnetisation will not reach saturation, but will increase with the field strength, being greater for a given applied field strength the greater the time between collisions and the weaker the molecular and demagnetising fields.

For the same swarm of magnetons subjected to an angular velocity Ω instead of a magnetic field with intensity H, we have, when the effects of collisions and the molecular and demagnetising fields are negligible,

$$I = NC/R.(U + \Omega).$$

The first and only important term is independent of Ω. Here the orientation is produced by the velocity

impressed, but only the time taken to reach the steady state is affected by its magnitude. The effects of collisions and of molecular and demagnetising fields are essentially the same as in Voigt's case.

Like Dr. Chapman and others, I have considered the possibility of dissociations increasing the intensity of magnetisation of hot bodies, and I have plans for experiments in this field. If the gyroscopic behaviour of a magneton is to account for cosmical magnetism (and it was the contemplation of this which led me to the rotation experiments), we must, as has long been evident, assume a constitution of the earth and sun different from that of materials on which experiments have previously been made.

On my theory, a magneton in a diamagnetic or paramagnetic body set into rotation is acted upon by the same alignment forcive as if alone or in a ferromagnetic body. But the intensity of magnetisation in the latter is small, for the same reason for which it is small when the body is placed in an ordinary magnetic field. In the former it is zero, because, on the assumption I have made, with Weber and Langevin, the magnetons are grouped rigidly together so that no element with a magnetic moment can have its orientation changed. This is the only point on which Dr. Chapman's theory, as I understand it, differs from mine. Rotation experiments on diamagnetic and paramagnetic bodies by Lébedew and by Mrs. Barnett and myself have hitherto given no magnetisation. S. J. BARNETT.

Washington, D.C., January 31.

I FULLY agree with Prof. Barnett's statement of the theory of magnetisation by rotation, and regret that through misunderstanding his treatment of magnetic intensity I suggested that his theory required modification. I am glad to know that he contemplates experiments on the rotation of hot bodies; this point, and the greater possibilities afforded if the magnetic elements remain intact at high temperatures, are the matters to which chiefly I wished to direct attention. Experiments made here with Dr. Oxley have negatived my suggestion that diamagnetic and paramagnetic bodies should also show magnetisation on rotation, thus confirming the previous results mentioned by Prof. Barnett; experiments on hot ferro-magnetic bodies are not yet advanced sufficiently to state whether they support the view that the earth's magnetism may depend on its high internal temperature. Further trial seems to preclude the possibility of trustworthy calculation at present, and the view must be tested by experiment. Until this is done it seems useless to enter into further details of the earth's field and its secular variation.

As regards the sun, later consideration of the narrow radial limitation of its magnetic field leads me to think that no simple magnetisation, by gyroscopic action or otherwise, is the probable cause; any such view requires two hypotheses, one to explain the production and the other the neutralisation of the field. A unitary hypothesis, such as the second of those indicated by Sir J. Larmor in the British Association Report for 1919, seems preferable.

S. CHAPMAN.

The University, Manchester, February 22.

Transcendental Premises in Science.

PERHAPS you will permit one who belongs to a considerable section of your readers who are neither mathematicians nor neo-physicists to state how the very remarkable discussion on Prof. Einstein's theory in NATURE of February 17 appears to some of us.

Mathematics to us is a very precise and complete form of deductive logic applied to space and number. It differs from ordinary logic only in having its arguments set out in a symbolical shorthand instead of in words, and thus enables a long deduction to be condensed into a short statement. This unfamiliar form of notation and condensation of the argument are the chief stumbling-blocks to the outsider.

Like other forms of logic, it is an art rather than a science, namely, the art of drawing legitimate conclusions from premises. In essence, it has nothing to do with the truth or falsity of the results. These depend entirely on the nature of the premises. The most faultless string of equations, like the most immaculate collection of syllogisms, may conclude with an absurdity or a stupendous error if the premises are faulty. The logical mill by which the results are obtained may turn out good flour or only chaff. This depends entirely on what it is fed with.

This is why the Philistine who is not a mathematician sometimes shakes his head when he is presented with a series of equations on the blackboard and his teacher says to him: "Look there. What do you say to that?"

What the Philistine doubts is not the accuracy of the deduction in this case, but the validity of the premises used in the new departure, which turns largely on the nature of space and time as defined by the neo-physicists. Granting that they are legitimate, the results are unquestionable. Are they legitimate? Let us turn to space. The first remark I would make is that, whatever its value, the definition in question represents something entirely and confessedly different from space as known to the great mass of men and to all philosophers, mathematicians, and physicists until the last few decades, and it has, therefore, no claim to be called space at all.

Space was defined by Newton by two predicates, namely, extension and immovability. I would presume to add a third one, quite necessary as things are now marching, namely, that any finite portion of space may be measured by three co-ordinates at right angles to each other and passing through one point—or, in other words, space has three dimensions. This is the only space known to human experience, as it was to the early geometers. The addition of a fourth or any number of other dimensions as factors of space is inconceivable unless we entirely alter the comprehension and connotation of the words "space" and "dimension." You may call the result what else you will; you are misleading a great many innocent people in calling it "space," like the Pragmatist is doing when he defines the "truth" he writes about as "the useful."

When Riemann read his famous paper before the Göttingen Academy at the instance of Gauss, who presided on the occasion, he first introduced the notion of space with more dimensions than three. He spoke entirely as a pure mathematician. His premises were not facts, but definitions of abstractions which could not materialise into realities. With his abstract postulates he was able to frame a series of equations which were quite legitimate in form, but the conclusions of which were also abstractions, and could not be presented in a mental picture or as representing anything in Nature. Since then, a large literature has grown up in regard to these phantasms of mathematical abstraction. Attempts—very futile attempts, as it seems to me—have been made to translate the conclusions of Riemann's equations into

pictures in which lines with the most wonderful contortions have been supposed to represent the effects of adding new dimensions to space. They are useful only as illustrations of the enormous gap separating this so-called hyperspace from the space of human experience. There have latterly been attempts to go much further and to import the creations of Riemann's imagination into the analysis of physical problems, into speculations on the construction of space beyond the range of human vision, and to postulate on the existence of space of different kinds, including curvilinear space, all of which I deem to be entirely outside the province of legitimate induction. The word "curvilinear" describes a predicate or function of matter, but not of space; as well might it be applied to a vacuum. Nor do I exactly know what Prof. Einstein means by relative space as used by him. The word "relative" has a perfectly recognised meaning in philosophy as the antithesis of "absolute." If it is used by him in this sense, assuredly there is no novelty in it. It was the fashion of the philosophers of the ancient world and of the schoolmen of medieval times to separate space and time from the other phenomena of Nature. They held that both have an objective existence, and are not, as they deemed, entirely subjective and transient, like the more obvious presentations of sense. There are many rebels against this notion now who claim that space is as much entitled to be called a subjective phenomenon as is colour or taste, and that a man void of the senses of sight and touch could have no cognisance of what we mean by space. As to the size of any portion of space being relative only, I happen to have myself a personal proof of it in the fact that, my two eyes having lenses of different curvature, any object seen with one appears to my consciousness as one-third larger than when seen by the other. In the sense here mentioned I understand the word "relative," but I fail to understand what Prof. Einstein means by it.

Meanwhile, let us try to be content with our limitations. One of the earliest antinomies recorded was the question of whether space is limited or unlimited. It remains an antinomy still, and must remain so. The one alternative is as incredible and unimaginable as the other, and the Sphinx refuses to reply when she is asked about it. There is no calculus available by which men with limited faculties and all prone to error can map out infinity, discover the secrets of the realms beyond the stars, and transcend the world accessible to our senses, and which alone can be equated with, and adequately tested by, inductive methods. Let us leave to the pure mathematicians the delightful occupation of rambling through wonderland with their imagination. It would be unreasonable to deprive them of their mental relaxations and amusements in the land of dreams in which they have such ample scope for mental dexterity. All I maintain is that these dreams are entirely out of place in that branch of inductive thought called science. My most gifted friend Mr. Hobson, of Queens' College, Cambridge, a very original mathematician, in a lucid account of the aims and purposes of pure mathematics, emphatically protests against mixing up that empyrean study with the mundane realities of plebeian physics.

Lastly, let us remember a graphic phrase of Mansel when dealing with transcendentalism in philosophy. He warned his pupils that "a man who tries to look down his own throat with a candle in his hand must take care that he does not burn his back hair."

I have touched only the fringe of the subject raised in this most interesting discussion, for which we are all grateful, but I feel that whether the space discussed in it is limited or not, yours is very definitely limited, and I must trespass on it no further.

HENRY H. HOWORTH.

45 Lexham Gardens, February 21.

Natural History of Porto Santo.

THE Island of Porto Santo, one of the Madeira group, is probably best known to biologists on account of the famous rabbit still found commonly there. Darwin showed that the animal differed conspicuously from the English rabbit, and inferred that it had evolved into a new race since its introduction into the island some hundreds of years ago. Haeckel gave it a distinctive name, *Huxleyi*. It is, indeed, a distinct race or subspecies from the English rabbit, but zoologists had failed to observe that it was identical with the Lusitanian animal, which had not then been segregated by them. Thus the Porto Santo rabbit loses its importance as evidence of evolution, being, in fact, the South European subspecies of *Oryctolagus cuniculus*.

To the modern biologist, however, Porto Santo has far more attractive features. It is a small island, some $6\frac{1}{2}$ miles by 3 miles, but of irregular shape, with a number of adjacent islets. Yet on this small area are found as many as forty-one native species of Helicoid snails, the very much larger island of Madeira having only thirty-seven. A few of the forty-one are now extinct, being represented only by fossils or empty shells. On the other hand, the number may be considerably increased if we add the varieties and local races, some of them quite distinctive. In addition to the native species, there are some which have been introduced, and *Helix pisana*, in particular, exists in countless myriads, with many variations. It seems to have been no obstacle to the spread of this snail that the island was already occupied by a prodigious number of land mollusca. Whether the advent of *H. pisana* reduced the numbers of the native species it is hard to say, but the latter still abound everywhere.

The largest and finest snail of Porto Santo is *Pseudocampylaea Lowei*, Férussac, or *gigantea*, Lowe. It is a quite common fossil in beds which must apparently be referred to the Pleistocene, but it has been found living, and a perfectly fresh shell is to be seen in the British Museum (Natural History). I found no living specimens, but obtained several shells in ploughed fields, showing the pink apex and traces of the bands; certainly not fossils. It may be that agriculture has been the principal cause of the extinction (it is probably now extinct) of this fine mollusc. *Leptaxis fluctuosa*, Lowe, is another species which seems to be extinct, but I found a recent shell showing the coloured banding. The islets about Porto Santo are extremely interesting. The Ilheo de Cima, on which the lighthouse stands, is about 1200 metres long and less than 500 metres across at its widest part. It is scarcely 300 metres from the main island, and there are half-submerged rocks in the channel. Yet on this islet we find swarming under stones the very distinct and remarkable snail *Geomitra turricula*, Lowe, found nowhere else in the world! The large *Pseudocampylaea portosanctana*, Sowerby, which is a sort of smaller edition of *P. Lowei*, abounds on the main island. But on the Ilheo de Cima it has not merely one distinct race, but two. On the top of the islet, near the end facing the main island, we find a very large, dark, depressed race, the greatest diameter

of which is 29–31 mm. This is the race *cimensis* of Wollaston. About the landing-place, on the east side, is another race, smaller than usual (maximum diameter 22–25 mm.), not dark, but well and conspicuously banded, and with the spire greatly depressed. It may be called race *evoluta*; it has possibly become distinctly segregated since Wollaston's time, since it combines the characters of the other forms, and is the sort of thing which might doubtless be obtained from them by careful breeding under artificial conditions. At the same time these races *cimensis* and *evoluta* exist to-day as pure types, very distinct and easily recognised, occupying different stations on the Ilheo de Cima.

In some ways the Ilheo de Nordeste, the most remote of the islets about Porto Santo, is even more interesting. It is a mere rock in the ocean, about 500 metres long and 300 metres high, somewhat less than 3 km. from the main island. With the aid of our boat's crew of strong Portuguese sailors, my wife and I were able to land and climb about the excessively rocky surface. The vegetation is scanty, but includes the beautiful stock, *Matthiola maderensis*, Lowe, and the orange-flowered Lotus. Ants and millipedes seemed to be entirely absent. On this lonely rock, and nowhere else, lives the beautiful snail *Cryptaxis forensis*, Wollaston, with dark, keeled shell and pink lip and apex. Here, and not elsewhere, is found (in great abundance) the small, button-like *Discula polymorpha* race *gomesiana*, Paiva. But here also is the invading *Helix pisana* and the native *Plebecula punctulata*, Sowerby, which abounds on the main island.

The curious little *Geomitra paupercula*, Lowe, abounds under rocks in dry places at Porto Santo and on the adjacent islets. It is unique in the group for its wide distribution, being found also in Madeira and all three Desertas, and in the Azores and Canaries. It sticks very tightly to the rocks or to any other convenient object. I once saw a beetle (Helops) walking along with one of these snails on its back. It is probable that at different times these snails have attached themselves to the feet of birds, and thus got carried across the sea.

The soundings taken many years ago by H.M.S. *Styx* (Capt. Vidal) show that Porto Santo rests on an elevated bank, indicating a former island perhaps six or seven times as large. The margins of this bank appear to be cliff-like, almost vertical, the depths suddenly increasing from, *e.g.*, 45 to 200 fathoms. This might be taken to indicate the cliffs of the former island, perhaps dating from the Mesozoic. The oldest deposits on the island containing fossils are Miocene, and are marine. At Calheta Point one may see this Miocene material, with large shells and corals, mixed with dark volcanic rock, which seems to have been thrust up from beneath. The suggestion is obvious that the island dates only from the Miocene, but, apart from the *Styx* soundings, it seems improbable that the remarkable snail fauna has wholly evolved from some immigrant or immigrants since that time. The sandy fossil beds containing land shells must be considered Pleistocene. Wollaston calls these shells subfossil, but they are quite comparable with Pleistocene fossils elsewhere, and show about as much difference from the living fauna as might be expected. At the base of this series, in the Campo do Baixo, is a dense stratum of marine Pleistocene, which has been studied and will, I hope, be fully described by my friend Senhor A. C. de Noronha, a very keen and able naturalist who was born in the island.

The insect fauna of Porto Santo is scanty, but the collections obtained will doubtless prove to be of exceptional interest when studied. Three species of butterflies are common, *Colias edusa*, *Vanessa cardui*, and *V. callirhoë*, the last breeding abundantly on the nettle *Urtica membranacea*, Poir. Wollaston considered that specimens of the Porto Santo *V. callirhoë* were smaller than those of Madeira, but I could not see any difference. We found only two species of bees, both Andrena. No fossorial wasps could be found, though the sandy country seemed exactly suited to them. The numerous spiders appear to have no Pompilidæ to attack them. At the back of the town rises the tall Pico do Castello, and on its summit may be seen a building in which the inhabitants used to take refuge from the Moorish pirates. A cannon remains on the side of the mountain, half-buried in the earth. To-day the lowlands of Porto Santo are overrun, like those of Madeira, by the obnoxious little ant *Iridomyrmex humilis*, which has exterminated the once-abundant house-ant, *Pheidole megacephala*. But on the top of the Pico do Castello we found the Pheidole still holding out, with numerous strong nests.

The flora is scanty, and was not specially studied by us. We were interested to find the orchid *Gennaria diphylla*, Lk., on the Pico do Castello and Pico d'Anna Ferreira. The Pico do Castello has been extensively planted with trees in recent years, and I thought the orchid might have been introduced with soil, but this seems unlikely in the case of the Pico d'Anna Ferreira, which remains in its original condition.

The people of Porto Santo are a hardy and industrious race who win a scanty living from the sea and soil. We found them exceedingly friendly and cheerful, and left them with strong feelings of regard. We were specially indebted to our guide, Senhor Juan do Pico, who knew every path and byway.

T. D. A. COCKERELL.

Hotel Bella Vista, Funchal, Madeira,
February 3.

The Energy of Cyclones.

IN the recent discussion in NATURE on the energy of cyclones no mention has been made of tropical cyclones, although these are the most remarkable phenomena of their kind.

It is impossible to apply to these cyclones the theories which ascribe the energy of the rotating wind system to the re-adjustment of equilibrium of warm and cold masses of air within that system, since in the cyclones of the tropical zone temperature and humidity are symmetrically distributed. In these cyclones warm and cold sectors do not exist. The Indian meteorologists Henry Blanford, Sir John Eliot, Fr. Chambers, and W. T. Willson have published papers on the cyclones of the Bay of Bengal and the Arabian Sea, giving a full explanation of their origin and development. These very important works no longer receive the attention they deserve. They also throw much light upon the source of energy in these cyclones. I endeavoured to make a rough calculation of the energy contained within one of these whirls, taking into account the preceding pressure distribution over the hurricane region, and the results were in good agreement with the observed wind forces. I should therefore like to direct attention to this work.

The calculation was based upon observations of the Backergange cyclone. It is given in my "Lehrbuch der Meteorologie" (1901 edition, p. 579, footnote), as well as in a paper, "Remarks on the Origin of (Tropical) Cyclones" (*Meteorologische Zeitschrift*, 1877, August, p. 311). My calculation has no ap-

plication to the cyclones of middle and higher latitudes, as it presupposes simple whirls like the symmetrical cyclone of the tropics. J. VON HANN.

Vienna, February.

The Ascent of Mount Everest.

THE opportunity which mountaineers and geographers have long looked for of approaching Mount Everest from the north has at last arrived. The Tibetan Government has given its consent for the dispatch of an expedition to explore the mountain. The expedition is now being organised by a combined committee of the Royal Geographical Society and the Alpine Club, and an attempt will be made to ascend this the highest mountain in the world.

The cost of the expedition is estimated at about 10,000*l*. Already a quarter of this amount has been raised among the members of the two societies. But the expedition will have to leave England very shortly, and it is essential to its success that the equipment shall be the best possible, and that no financial uncertainty shall delay the organisation in India of a picked corps of Himalayan porters and of an adequate transport service. Heavy initial outlay is therefore involved, and we now appeal to the general public, confident that it will wish to further an enterprise the successful accomplishment of which will bring so much credit to this country.

Subscriptions should be sent to the Treasurer, Royal Geographical Society, Kensington Gore, S.W.7, or to the Bank of Liverpool and Martins (Cocks, Biddulph, and Co.'s branch), 43 Charing Cross, S.W.1.

FRANCIS YOUNGHUSBAND,
President, Royal Geographical Society.
J. N. COLLIE,
President, Alpine Club.

February 23.

Pure Organic Chemicals.

I AM glad to see that the writer of the leading article in NATURE of February 24 directs attention to the concern with which research workers view the possibility of foreign organic chemicals being restricted or excluded by legislation in the interests of British manufacturers.

The latter are not yet in a position to supply many materials in that state of unquestioned purity such as one associates with the old firms of Merck and Kahlbaum in Germany and Poulenc Frères in France.

As an illustration I may mention that I recently ordered a pound of propyl alcohol (as catalogued) from a British firm, and at the same time a like quantity from Poulenc Frères. The first forwarded a material costing 18*s*. which consisted of a mixture boiling over a wide range of temperature but containing no propyl alcohol, whereas the French firm supplied a pure sample of nearly constant boiling point costing 11*s*., including postage. J. B. COHEN.

The University, Leeds, February 25.

Nature of Vowel Sounds.

WITH regard to the very interesting researches on vowel sounds by Prof. Scripture published in NATURE of January 13 (p. 632) and January 20 (p. 664), I beg to be permitted to state that the attempt of Helmholtz to produce vowels with smooth, simple tones has since been fully confirmed. Using, instead of tuning-forks, bottles caused to sound by currents of air blown over their orifices, which, as is well known, give almost perfectly simple tones, I have been able to demonstrate this myself. The remarkable and extended investigations of Prof. Miller described in his book, "Science of Musical Sound," have fully proved the statement of Helmholtz to be true, as have also the researches of Prof. Stumpff, of Berlin. I am therefore of the opinion that the Helmholtz theory of vowel sounds can scarcely be doubted any longer. Hermann's and Scripture's method of producing vowels by sending puffs of air through a resonator does not contradict this. Whenever a complex vibration is set up which appears to be a mixture of simple tones corresponding to the sound of a vowel, there will be produced a vowel. However, it is very important to have repeated Hermann's experiments and extended them by using resonators with soft walls.

CHARLES DE WESENDONK.

Hôtel Eden, Montreux, Switzerland.

THE above letter very properly directs attention to the excellent work of Prof. Miller. It is worth while to study Fig. 130 of his book, reproduced below. For the tuning-fork there is only one tone, namely, the fundamental. For the other instruments the fundamental appears clearly, but for the voice the fundamental is lacking. Thus the strongest tone in a vowel, the voice tone, does not appear in the plot. This is in agreement with the work of Hermann and myself. As explained in NATURE of January 13 and 20, this arises from the fact that the voice tone consists of a series of puffs.

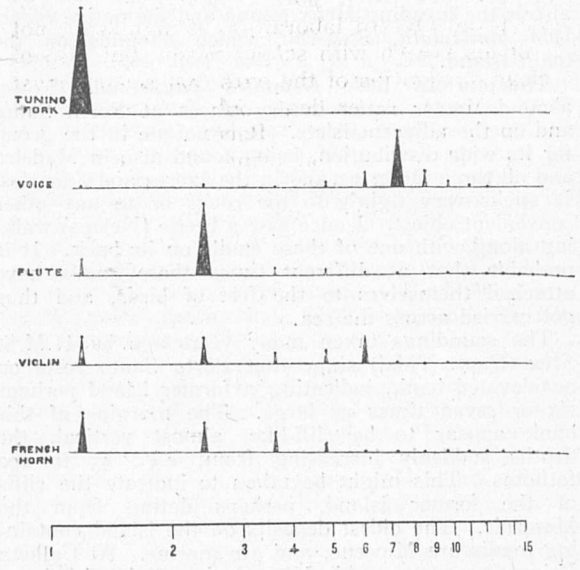


FIG. 1.—Distribution of energy in sounds from various sources

Prof. Miller's plots show that for the musical instruments the harmonics appear strongly at certain places. For the voice, however, the seventh, eighth, and ninth harmonics appear. Three tones in the relations 7 : 8 : 9 sounded together would produce a most discordant sound with disturbing beats, and certainly not the clear tone that characterises a vowel. As explained in NATURE, such a group of neighbouring harmonics arises from the presence of an inharmonic in this region which can express itself only in this way.

It is interesting to note that Prof. Miller's results give direct evidence of both elements of the new vowel theory, namely, that the voice tone consists of a series of puffs, and that the vowel tones are independent of the pitch of the voice tone. From Prof. Miller's plots they would appear always to be inharmonic. E. W. SCRIPTURE.

Early Chemistry in Oxford.[1]

By SIR EDWARD THORPE, C.B., F.R.S.

AN attempt is being made at Oxford to bring together such scattered information as exists concerning the early history of science in that University, and to commemorate the achievements of Tunstal, Richard of Wallingford, Merle, Mauduit, Rede, Aschenden—forgotten worthies of a medieval time—and of Digges, Recorde, Dwight, Lower, Mayow, and others of a later period. As regards physical science, it is intended to illustrate its development by a sort of *catalogue raisonné* of scientific instruments, mainly from the collections in the various colleges and University departments which are known to be rich in specimens of the best work of the craftsmen of the seventeenth and eighteenth centuries.

The present booklet—the first instalment of the projected series—deals with the history of chemistry at Oxford down to the time of Daubeny. It traces the beginnings from Roger Bacon (1214–92), who may be said to have well and truly laid its foundations as a science by his insistence on the appeal to experiment. His dictum, *Sine experientia nihil sufficienter sciri potest,* now over the entrance to an Oxford laboratory, is significant not only of his breach with scholasticism, but also of his clear recognition of the path that science must follow. Mr. Gunther deals only in very general terms with the influence of Bacon—more with his teaching and the essential nature of his philosophy than with his actual achievements. He sees his limitations in the dominance of the Greek philosophy, and in his inability to act, through force of circumstances, upon his own principles. Considering that Bacon's name is associated with Oxford traditions, and that the book is primarily intended for Oxford students, to whom, indeed, it is dedicated, more space might well have been allotted to one who was "at once the earliest and among the greatest of our [Oxford] teachers."

The early association of chemistry with medicine was, of course, felt in Oxford, as elsewhere. The Spiceria of medieval Oxford were to be found in the High Street, near the site of the present front of Brasenose College. Their shops, which did not escape being occasionally "ragged," dealt originally in spices, seeds, and roots, and only gradually developed into apothecaries. One of the earliest was that of John le Spicer, whose shop, in 1332, was in All Saints parish. Mr. Gunther furnishes a plan showing the apothecaries' quarters in Oxford, and he gives illustrations of their receptacles for drugs from the series in the Ashmolean Museum.

From the times of Roger Bacon and the early spicers to the middle of the seventeenth century is a big jump. But Oxford contributed nothing to chemical science during the intervening period. The study of natural phenomena was foreign to the scholastic learning of the time. As Mr. Gunther points out, "the long list of Waynflete readers of Natural Philosophy, none of whom left any original work, shows how barren discourses on this subject must be, when they are founded on Aristotle rather than on Nature." There were, however, alchemists during this period in Oxford, among them the Rosicrucian Fludd, of St. John's, in 1591, and Simon Forman and John Thornborough (1602), of Magdalen. Mention should also be made of John French (1616–57), who wrote treatises on distillation, "partly taken out of the most select Chymicall Authors of several Languages, and partly out of the Author's manuall experience." But the real awakening in Oxford occurred during the troubles of the Civil War, when Wilkins, Ward, Bathurst, Petty, and Willis met weekly, first in an apothecary's house for "the convenience of inspecting drugs," next at the lodgings of Dr. Wilkins, warden of Wadham, and afterwards at the lodgings of Mr. Robert Boyle. The last-named had settled, in 1654, in Crosse's rooms in the High Street, having recently left Ireland, "a barbarous country," he says, "where chemical spirits were so misunderstood, and chemical instruments so unprocurable, that it was hard to have any Hermetic thoughts in it."

This association of the progenitors of the Royal Society with Oxford is an incident of which the University is justly proud, and Mr. Gunther treats of it in some detail. Boyle, who was of a tender constitution, was devotedly looked after by his sister, Lady Ranelagh, who came up to Oxford to settle him in his lodgings. While there, we learn from a letter which Mr. Gunther prints, she was not wholly satisfied, as she thinks the position of the doors with respect to the fireplace, even in the warmest room, will occasion draughts, "the inconvenience" of which "may be helped . . . by a folding screen." Boyle, however, was sufficiently comfortable to remain there for fourteen years, when he removed to London to his new laboratory at the back of Lady Ranelagh's house in Pall Mall. Crosse's house in Oxford was pulled down in 1809; it was where the Shelley memorial now stands. Mr. Gunther gives a reproduction of an old print showing it and its relation to University College and other buildings in the High Street (Fig. 1).

Oxford owes to Boyle its first regular teacher of practical chemistry—Peter Sthael, of Strassburg, "a Lutheran, a great hater of women, and a very useful man," who had been engaged by Boyle as one of his assistants. He began his courses in 1659. Among his pupils was John Locke, of Christ Church, "a man of turbulent spirit, clamorous and never contented. The club [class] wrote and took notes from the mouth of their master, who sat at the upper end of a table; but the said J. Lock scorned to do it; so that while every man besides of the club were writing, he would be prating and troublesome." That the fingers of the troublesome J. Locke did actually itch to be at chemical experimenting is shown by

[1] "Early Science in Oxford." Part i., "Chemistry." By R. T. Gunther. Pp. vi+91. (Oxford: The Oxford Science Laboratories, 1920.) 6s.

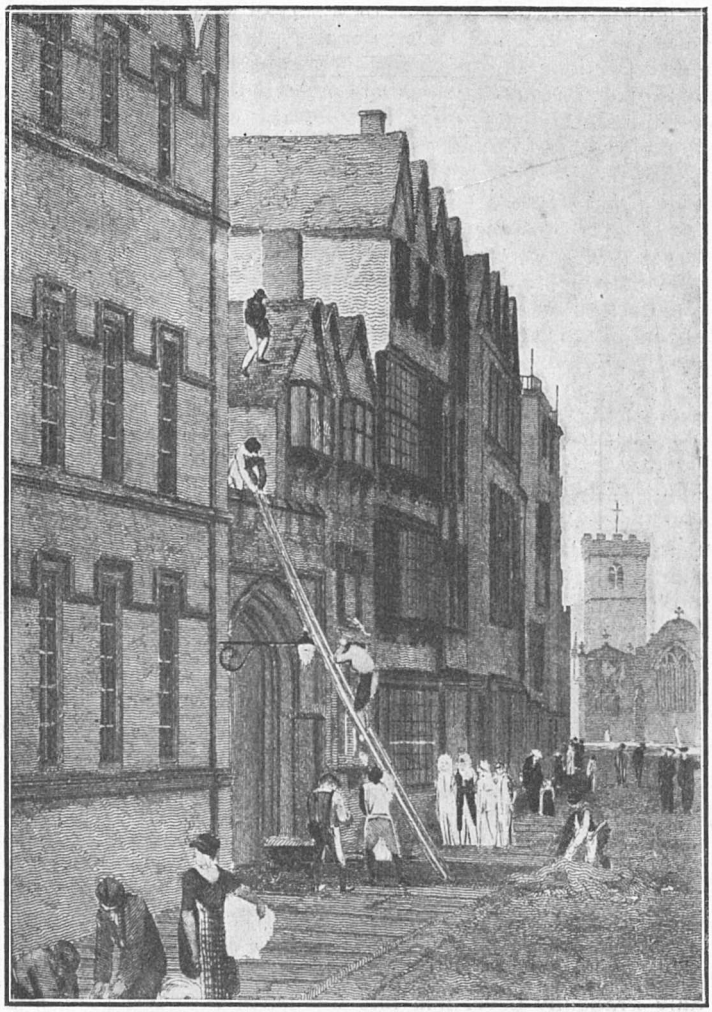
his subsequent action, for an account of which we must refer to the book itself.

Oxford is associated with the discovery of the art of salt-glazing stoneware, due to John Dwight (1661), of Christ Church. John Ludwell, fellow of Wadham, about 1670 experimented on the manufacture of glass, which he surmised was a kind of solution.

With the removal of the members of the "philosophicall Clubbe" to London, the pursuit of experimental inquiry languished and almost died out. The chief glory of Oxford in the years immediately following the Restoration was John Mayow, fellow of All Souls, who left the University in 1675 and settled at Bath as a physician. He died four years later at the age of thirty-six. On his epoch-making work—his "Tractatus de Respiratione," in which he recognised the real nature of atmospheric air, and of the function of one of its constituents in supporting combustion and respiration—as also on his subsequent treatises in which he further elaborated his practical discovery of oxygen, there is no need to enlarge. Mr. Gunther styles him "the greatest chemist whom Oxford has ever produced."

The first University chemical laboratory was established by Elias Ashmole, whose original scheme for the foundation of a scientific institution comprised an "elaboratory," as well as a repository for his "raree show" of archæological curios. The *Officina Chymica* was housed in the cellar of the building, which was erected in 1683, and placed under the charge of Dr. Plot. "Certaine scholars" of the Philosophical Society of Oxford thereupon "went a course of chimistrie" and "had meetings in the large room over the elaboratory Every Friday in the afternoone to talke of Chymicall matters," "their discourses" being "registered down" by Dr. Plot. Plot resigned his office in 1689, and was succeeded by Mr. Edward Hannes, of Christ Church. In 1704 Hannes was followed by Dr. John Freind, also of Christ Church, who is described as "well-skill'd in Speculative and Practical Chymistry," and "the first who applied the Newtonian philosophy to chemistry." He was assisted by Richard Frewin, of the same college, and Camden professor of ancient history, who seems to have had charge of the Ashmolean Laboratory. The latter, according to Uffenbach, the traveller, who visited it in 1710, "does not trouble much about it, and the operator, Mr. White (said to be a good-for-nothing man) still less." "Not only are the finest instruments, tiles, and such like, almost all broken to pieces, but the whole place is filthy." Mr. Gunther is of opinion that at least one good thing emerged from the furnaces of the Ashmolean—namely, Dr. John Wall, a fellow of Merton, who probably gained there the knowledge of operative chemistry which enabled him to study the manufacture of porcelain, and ultimately to found the famous china factory of Worcester.

Another Dr. Wall, known as Martin Wall (1747–1824), a fellow of New College, in 1781 became public reader of chemistry. He, according to our author, taught that chemistry "is an immediate revelation from Heaven to Adam, and had its name from Cham, the progenitor of the Egyptians." "Chymistry" is not only "a piece of knowledge not mis-becoming a gentleman, but it promises to afford a firm and elegant basis for a compleat skill in Natural Philosophy—and certainly will enable any divine in Europe to describe with confidence the operation by which Moses might have reduced the golden calf to powder—to the confusion of Voltaire and all his disciples."



University College. Crosse's. Three Tuns. Tillyard's.

FIG. 1.—Site of Boyle's Laboratory. From "Early Science in Oxford."

The early memoirs of the Manchester Philosophical Society contain several papers by Wall, brief notes of whose lectures are preserved in MS. in the Radcliffe library and in private letters of the time; some of the latter are printed by Mr. Gunther. Wall is described as a "learned, ingenious, and pleasing gentleman," who once had the honour of drinking tea with Dr. Samuel Johnson.

A contemporary of Wall's, James Higginbotham, of Magdalen Hall, afterwards James Price, of Guildford, was the last of the English alchemists, and killed himself after the exposure, by a committee of the Royal Society, of his pretensions to transmute mercury into gold.

From the closing years of the eighteenth century to the time of the foundation of the Aldrichian professorship, Oxford readerships in chemistry were held in succession by Dr. Thomas Beddoes (1788–93), best known as the founder of the "Pneumatic Institution" at Clifton, and the discoverer of Humphry Davy; and Dr. Robert Bourne, a fellow of Worcester, and an eminent medical man of his time. Indeed, practically all the readerships were held by medical men, and their teaching was largely directed to the needs of medicine.

In 1803 Dr. G. Aldrich endowed a professorship of chemistry. The first occupant of the chair was John Kidd, who held it from 1803 to 1822. He is the author of two papers in the Phil. Trans., one on "Naphthaline, a peculiar substance . . . produced during the decomposition of coal-tar"; the other on "The natural production of Saltpetre in the walls of subterraneous buildings," the saltpetre having been scraped from "the hoary walls" of the basement of the Ashmolean Museum in which Dr. Kidd and his family resided.

Dr. Kidd was succeeded by Dr. Charles G. B. Daubeny, a professor of botany to chemists, and a professor of chemistry to botanists, who held the chair for thirty-two years, when his "increasing duties at the Botanic Garden compelled him to resign his Chemical Professorship." The cellar at the Ashmolean, although, as Daubeny said, "notoriously unworthy of a great University, being dark, inconvenient, and confined," was afterwards occupied by the late Prof. Story-Maskelyne, who gave instruction there in chemical analysis. An incident connected with his tenancy of this basement is related by Mr. Gunther in a footnote with which this notice of a most interesting account of Oxford's relations to chemistry must conclude:—

> Some workmen were employed to make some alterations to a wall when one of them drove his pick through into a small room that had evidently not seen the light of day for generations. They enlarged the aperture, and, on entering, found some bottles that appeared to them of extreme antiquity. Very naturally they tasted the contents and speculated on the possible origin of the long forgotten hoard. When eventually the discovery was reported to Maskelyne, then at the mineralogical department at the British Museum, he exclaimed, "They have broken into my cellar, the stupid idiots. If they had only looked at the other side they would have seen my new oak door." But what probably rankled in his mind was the thought that his own gin had impaired their clear vision.

Mr. Gunther's surmise cannot, however, be well founded, as the gin was reached only *after* the wall had been broken through. It was presumably the same wine cellar that Dr. Daubeny had vainly petitioned Convocation to improve for him.

Pons-Winnecke's Comet and its Meteor Shower.

By W. F. DENNING.

A NEW comet was discovered by Jean Louis Pons at Marseilles in June, 1819, and it was observed during five weeks. From the observations obtained, Encke computed that the comet was revolving in an elliptical orbit, with a period of 2052 days, or 5·618 years. Nothing more was, however, seen of the object until nearly forty years afterwards, when Winnecke re-discovered it, and also re-determined its period of revolution. It has since been observed in 1869, 1875, 1886, 1892, 1898, 1909, and 1915. During the last fifty years the planet Jupiter has somewhat disturbed the orbit of the comet, for the two objects made several near approaches. Two periods of the comet are nearly equivalent to one period of Jupiter, hence at alternate visits of the former to aphelion, as in about 1872, 1883, 1895, and 1907, the perturbations were considerable. These had the effect of lengthening the comet's period and bringing that section of its course which is nearest to the sun almost into conjunction with the earth's path at the end of June.

On June 28, 1916, a meteoric shower of striking and abundant character was observed by the present writer at Bristol. It was first seen there at 10.25 p.m., and half an hour later it was also observed from Bournemouth and Birmingham. The sky was not very favourable, but at Bristol sixty-nine meteors were observed in about two hours, including twenty of the first magnitude, and the radiant point appeared to be diffused over the region of η Ursæ Majoris, θ Boötis, and a little east. This position corresponded approximately with the radiant point computed for Pons-Winnecke's comet, and the date was also correct, so that an intimate association (or identity) of the two phenomena was suggested (see Monthly Notices of the Royal Astronomical Society for 1916, vol. lxxvi., p. 742). The meteoric shower named is likely to be repeated, and on a more brilliant and abundant scale, on about June 27 next, for the comet will be very much nearer to the earth than it was in June, 1916. On that occasion the meteors were seen about ten months after the comet's nucleus had passed through perihelion, so that the stream of

particles following in the comet's wake must have been something like 550 million miles long. This need not, however, occasion great surprise, for observations have proved that in the case of the great Leonid stream of November the débris or meteoric particles are distributed completely around the orbit, which extends in its outer limits to beyond the path of the remote planet Uranus.

Formerly we had no special meteor shower to distinguish the midsummer period, but it is quite possible that in future years June may acquire a similar notoriety for meteors as that which has been long held by August and November, and should the new shower fully justify expectation it will in a certain measure prove a recompense for the lack of grand displays of meteors which has characterised the past thirty-five years. There were great storms of meteors in November, 1866, 1872, and 1885, but the Leonids of Tempel's comet (1866) and the Andromedids of Biela's comet have failed to furnish a really brilliant display of first-class importance during more than the third of a century, and it seems difficult to predict the dates of great revivals, although the years 1933 and 1934 are likely to bring a considerable shower, if not a grand exhibition, of meteors at the middle of November.

Including the periodical comet of Pons-Winnecke, we now have six comets of which the orbits bear so striking and suggestive a similarity to those of rich meteoric streams that we may certainly conclude them to have the same derivative sources. There are also a number of other comets which furnish significant evidence that they are closely connected, if not identical, with active meteor showers. For example, the comet of Mechain-Tuttle seems to present conformity with a radiant point observed from 220°+76° from December 20 to 25. The comet Lexell (1770) agrees with a radiant point in June at about 280°–24°. The comet of 1739 agrees with a radiant point at 153°+40° from October 14 to 22, and the comet Denning (1881) presents similar features of orbit to a meteor shower observed during the period July 25 to August 8 from a radiant at 303°–10°.

There are many other instances in which cometary and meteoric accordances may be assumed with a fair degree of probability, yet when we consider the large number of orbits now definitely computed for comets and meteor streams we are bound to admit that chance coincidences must sometimes occur, and that it is difficult, except in special cases, to select the genuine instances of agreement.

Obituary.

PROF. L. C. MIALL, F.R.S.

THE death of Prof. Miall, announced in our columns last week, removes from the world a man who stood in natural history eminent in a position of his own, in education as one of the most sane and enlightened reformers of his time, and in personality one of the truly great among men.

Louis Compton Miall was born in 1842, the son of a Congregational minister in Bradford. After his early education at Silcoates he entered the teaching profession as an assistant master, but was soon tempted to accept the curatorship of the newly founded Literary and Philosophical Society of Bradford, where he developed a keen interest in geology and palæontology. A little later he was appointed to the curatorship of the Museum of the Leeds Philosophical and Literary Society, and in 1876, two years after the foundation of the Yorkshire College of Science, he was appointed as its first professor of biology, a position which he continued to hold in the University of Leeds until his retirement in 1907. With Sir Edward Thorpe, the late Sir Arthur Rücker, and Prof. A. H. Green he was one of the four scientific pioneers of university education in Yorkshire. He held the Fullerian professorship of physiology in the Royal Institution, 1904–5, was president of Section D (Zoology) of the British Association at the Toronto meeting in 1897, and president of the Education Section at Dublin in 1908. He was elected a fellow of the Royal Society in 1892, and made an honorary D.Sc. of Leeds in 1904.

On his retirement from Leeds in 1907 Prof. Miall took up his residence at Letchworth, within easy reach of Cambridge and of the British Museum, and he continued active in writing and teaching. In 1918, soon after the death of his gifted wife, to whom he was married in 1870, he returned to his native county, residing at Ben Rhydding. For some time he maintained an active interest in his books, and he left practically complete a work on "Garden-craft in the Past." Latterly his health failed somewhat, but almost until his death he retained wonderful vigour of mind and intellectual interest. In the middle of January he had a slight paralytic stroke, followed by a second, which left him in a weak state. From then his strength slowly ebbed, and he passed away peacefully, without suffering, in the house of his daughter, Mrs. Harold Wager, at Leeds.

To those who did not know him it is scarcely possible to give an adequate idea of the kind and strength of the influence which Prof. Miall exercised, or of the veneration in which he was held wherever his labours lay. In attempting to describe any section of his work there arises at once the memory of the man himself, his arresting personality, the scale and strength of his principles of heart and mind, his austere simplicity and perfect sincerity, his deliberate judgment, the comprehensiveness and sanity of his mental atti-

tude, his perfect lucidity of thought and speech, the richness and rarity of his store of learning in so many fields, and the scrupulousness of his taste, which abhorred and swept before it all that partook of the pretentious or the base.

Prof. Miall's intellectual interests were not confined to science. He had a real love of art and music, and was keenly interested in the works of Greek and Latin authors and in the classics of English, French, and German literature. His activities in biology, both as teacher and as investigator, coincided with the great output of biological work which followed upon the publication of Darwin's "Origin of Species." His earlier scientific memoirs were mainly geological and palæontological. Shortly after he was appointed curator of the Museum at Bradford he was instrumental in bringing to light a newly discovered Labyrinthodont which had been found in a coal mine at Low Moor. It was in connection with this discovery that he first made the acquaintance of Prof. Huxley and Sir Charles Lyell, and the incident seems to have been a turning point in his career. Between the years 1869 and 1881 he published numerous papers on geology and palæontology. He also wrote a manual for students on "The Skull of the Crocodile," and, in conjunction with F. Greenwood, an important memoir on "The Anatomy of the Indian Elephant."

From 1881 onwards Prof. Miall's biological investigations were mainly confined to the structure and development of insects, and his books on "The Cockroach," "The Harlequin Fly," and "The Natural History of Aquatic Insects" are among the most important memoirs on insect structure and development published during the latter half of the nineteenth century. These books, which are written with great lucidity and charm, have been an inspiration to many naturalists, and are enduring examples of how to "study the works of Nature with open eyes."

In his love of Nature Prof. Miall had very much the temperament of Gilbert White, and in collaboration with his friend Dr. W. Warde Fowler he brought out a scholarly edition of "The Natural History and Antiquities of Selborne," enriched with an abundance of notes explaining and amplifying Gilbert White's observations. The historical side of biology always had great attractions for him. He paid attention to it in his teaching, and two books from his pen, "A History of Biology" and a remarkably interesting account of "The Early Naturalists and their Work," testify to the wide range of his reading and the great knowledge which he possessed.

Prof. Miall's zeal as an educational reformer is well known. In his book on "Thirty Years of Teaching" his ideals and aspirations are clearly set forth, and in his "Object-Lessons from Nature," "Round the Year," and "House, Garden, and Field" he has given a most delightful insight into the methods which should be employed in the rational study of natural history as opposed to mere collecting and the compilation of lists of species. He was far from disparaging the study of systematic zoology or botany, but he did most strenuously deprecate aimless work "which springs from no real curiosity about Nature and attempts to answer no scientific questions." He loved Nature with all his heart, and ever served her faithfully.

A. S.; H. W.

By the death of Prof. Louis Compton Miall, emeritus professor of biology in the University of Leeds, there passes away the last but one of the small body of teachers—less than a dozen in number—who, as members of the professoriate of the Yorkshire College, may be said to have laid the foundations of the University and, in a measure, to have fashioned its aims and destiny. The Yorkshire College, the progenitor of the University, was established in Leeds in 1874. Miall, who at that time was secretary and curator of the Museum of the Philosophical and Literary Society of Leeds, had acquired more than a local reputation as a geologist and botanist, and was then embarking upon the biological inquiries upon which his position as a man of science mainly rests. He was known throughout the West Riding as an excellent teacher and an admirable lecturer who could always command the interest and sympathetic attention of his audience. It was inevitable that the college should seek to secure his co-operation as a member of its staff. He joined it first as lecturer, and afterwards as professor of biology in its second session, and his appointment marks a turning point in its history. In its earliest days its governing body had no clearly defined policy concerning its scope and functions. It had been established partly in response to a demand for greater facilities in technical education, and partly from a desire to see in Yorkshire an institution similar in character to that of Owens College in Manchester. One section would make it a technical or trade school pure and simple, whilst another section, of more liberal views and with more sympathy towards the *literae humaniores*, hoped it might develop upon broader lines. The accession of Miall determined the issue; biology had no immediate or obvious place in the curriculum of such a trade school as was then contemplated. Professors of art subjects were thereafter added as quickly as the finances of the struggling institution permitted, and the college was thus fairly placed upon lines that directly led first to its inclusion in the federated Victoria University, and eventually to its independent establishment as the University of Leeds.

The turn in the fortunes of the Yorkshire College was without doubt largely determined by the personality and character of Miall and by the respect in which he was held by all who knew him and had the interests of the institution at heart, whatever might be their conception of its functions. By no section of the body corporate was he more warmly welcomed than by the staff.

They had already learned to appreciate his powers and capacity and to admire his manifold attainments. He was a cultured, well-read man with many interests, literary and scientific, a somewhat fastidious critic with a high standard of excellence, but with sympathy and of sound judgment. As a colleague he was all that a colleague should be—unselfish, painstaking, hard-working, and loyal, always ready to put his knowledge and his experience at the service of his fellows. In the college councils he was never argumentative or captious—a man of few words, disposed more to listen than to speak. When he did intervene in a discussion what he said was weighty and strictly to the point, and seldom failed to convince the majority of his colleagues. His sense of fairness, his impartiality, and his freedom from prejudice made him strive to see the other man's point of view and to give it its due weight. This was so obvious that it gave his judgments much of their power and influence. One felt that when Miall reached a conviction, and gave utterance to it in his characteristic slow and deliberate tones, he was probably right.

The development of the Yorkshire College, as compared with that of Owens College in its early days, was comparatively rapid. The times were of course different, and public appreciation of the benefits of such institutions was far greater in 1874 than in the early 'fifties. Moreover, the Leeds institution had never to struggle against the prejudices, religious and social, which at the outset dogged the progress of John Owens's foundation. But this rapid development was not unattended with its crises. There were times of difficulty and of anxiety which the teaching staff was called upon to share. It was on such occasions that Miall's strong common sense, sound judgment, knowledge of affairs, and business aptitudes were of special service, as, for example, in the movement to house the college in more appropriate and more dignified quarters than it at first possessed; in the discussions concerning the plan and arrangements of the projected new buildings; and finally during the course of the delicate negotiations which preceded the federation of the college with the Victoria University.

As one who took his fair share in the various stages of the development of the college during the first eleven years of its existence, and recalls its early struggles, and their outcome, with no small measure of satisfaction, it affords me a special gratification to bear testimony to the loyal and devoted service of one of the truest friends the University of Leeds ever possessed.

T. E. THORPE.

THE Editor invites me to write a few words about the late Prof. L. C. Miall, a man whom I seldom met, but when I did, always with interest and pleasure. More than twenty years ago, when we were editing White's "Selborne" together, I wished to know more of him, and invited him to Oxford for a Sunday. It was like him to have brought no evening dress, but we had a fruitful time, and I found in the man a rare simplicity of mind and manners, and a great interest in his own experience, which he perhaps imparted more freely to a classical man than to one of his own circle. I heard the early history of the chance given him through Prof. Rolleston: how he asked a question after a lecture and was invited to talk it over next day before Rolleston left for Oxford, the result being that Rolleston stayed all day to talk to him and thereafter never forgot him. I heard the story of the little society of scientific men formed to read Homer, and later on he wrote me several letters about the best way to teach a boy Latin: a job which in his "emeritus" days he greatly enjoyed, doing it of course in his own peculiar and independent way.

Miall's enthusiasm in his own work was unbounded, and to communicate it to others the great delight of his life. He fairly astonished me, after a visit here at Kingham, by sending me as a gift the five splendid volumes on insects of Réaumur, and later on his own book on the early naturalists, one as great a treasure as the other, for his own beautiful English was as clear and enjoyable as Réaumur's French. He did, in fact, fit me out with a simple apparatus following the course of his own studies, so intensely did he wish his friend, only five years younger than himself, to share his enthusiasm. He once gave me a whole morning's microscopic teaching in his laboratory at Leeds, but though he fitted me out to continue his course I had no time to do so. That at my age he should have thought it possible shows the simplicity of his mind. Miall was one of those men who love teaching for its own sake, and the charm of his personality was such that I spent the time gladly and gratefully. But it was difficult, I found, to get him to bring his mind to bear on something quite new and out of his own experience. At Kingham I once took him to see the work of some mice in a flooded meadow which was new to me, but he had something else which he was expounding to me at the moment, and was not to be enticed. I shall always cherish his memory as one of the straightest and simplest Englishmen I ever knew.

W. WARDE FOWLER.

PROF. R. B. CLIFTON, F.R.S.

PROF. ROBERT BELLAMY CLIFTON was born on March 13, 1836, and so had nearly completed his eighty-fifth year when he died on February 21. The only son of a Lincolnshire gentleman, he received his education at University College, London, and at St. John's College, Cambridge, coming out sixth wrangler in the Tripos of 1859 and second Smith's prizeman, the senior wrangler and first Smith's prizeman being Canon Wilson. His Cambridge record is typical of his subsequent career; he was a man of great learning, but also of great deliberation. Obtaining a fellowship at St. John's, he went to Owens College, Man-

chester, in 1860 as professor of natural philosophy, and was appointed professor of experimental philosophy in the University of Oxford in 1865, which appointment he held until 1915.

The position of physics in 1865 was very different from what it is at the present time; there was then no such thing as a physical laboratory actually built for the purpose. Clifton's first work was the building of the Clarendon Laboratory, which was completed in 1872. The architect, no doubt, was responsible for most of the exterior, but the interior fittings down to the minutest details were practically carried out from Clifton's own working drawings. The necessary funds came from the trustees of Edward, second Earl of Clarendon, an alternative competitor for these funds being a riding-school.

The laboratory having been built, it had to be equipped with apparatus, which was a labour of love to Clifton, who was a born instrument-maker. Much of the apparatus is of his own designing, with the result sometimes that when an instrument had been brought to perfection it had become too sacred to be entrusted to the common herd.

Clifton was an excellent and inspiring lecturer, and spent an enormous amount of time in designing and fitting up apparatus for lecture purposes, so that his lectures were often more of the nature of laboratory demonstrations; time, however, was no consideration; no student could hope to get through even one subject during his academical life. He devoted himself to his pupils, both in Oxford and afterwards in obtaining posts for them. Besides lecturing, he took a large share in the laboratory instruction. This consisted almost entirely of repetitions of known experiments carried out with as much accuracy as possible. Research in the modern sense was not welcomed with open arms; the apparatus was too jealously guarded; but every student received a sound grounding in accurate experimental work, which no doubt bore good fruit later in many cases.

Clifton served on the council of the Royal Society for several years, was president of the Physical Society from 1882–84, was on the Royal Commission on Accidents in Mines from 1879–86, and at the same time had an estate in Lincolnshire to look after. All this, combined with his teaching, kept him constantly engaged, as he worked very thoroughly and deliberately at anything he took up, so that he had very little time left for original work; his published papers, in fact, are very few.

Clifton's method of private work was peculiar; he was popularly supposed to begin about midnight, and to go to bed with the "hooter," the Great Western Railway whistle which is sounded at Oxford at 5.30 a.m.; as he never took any exercise, it was a mystery how he managed to maintain his general fitness.

Clifton married in 1862 Miss Catharine Elizabeth Butler, and during her lifetime kept a most hospitable house. Every Sunday he had some of his students to lunch, having previously furnished them with a sketch of the route to his house. He was a most lovable man, who had the affection of all his pupils, and was a welcome addition to any company.

PROF. W. ODLING, F.R.S.

ON February 17 the death occurred at Oxford of the former Waynflete professor of chemistry, in his ninety-second year. For many years the name of Prof. Odling has been almost unknown to students of chemistry, except to those who have become acquainted with something of the history of their subject during the last century. But it deserves to be held in respectful remembrance both by students of chemistry and by the large body of professional chemists now practising in this country, though probably only a contemporary could appreciate at their full value Odling's services to science on one hand, and on the other the position of influence in relation to applications of chemistry which he held fifty years ago.

William Odling was born in Southwark in 1829, the son of a surgeon. After leaving school he studied medicine at Guy's Hospital Medical School, and graduated M.B. Lond. with honours in physiology and comparative anatomy in 1851. Before this time, in 1848, he had shown his bent in the direction of chemistry by becoming a fellow of the Chemical Society, then in the early days of its existence. He never practised medicine, but proceeded to Paris in 1851, where he placed himself under the famous Alsatian chemist Gerhardt, and so received some impress from his teacher which doubtless influenced his attitude later as an exponent of chemical theory. In 1856 he became one of the hon. secretaries of the Chemical Society, being associated during the first nine years with the late Prof. Redwood, and during the last four with the late Mr. A. G. Vernon-Harcourt. In the years 1860 to 1872 Odling gave great assistance to the English chemists of his time by his masterly discourses at the Chemical Society on subjects such as the fixation of atomic weights, valency, and classification, then matters of frequently hot debate.

From 1868 to 1872 Odling held the Fullerian professorship at the Royal Institution, previously held by Faraday, and in 1872 he moved to Oxford, having been appointed Waynflete professor of chemistry in succession to Sir Benjamin Brodie. His appointment he retained for forty years until he retired in 1912. Oxford at the time of his appointment was still too much under the conservative influences which had for so long retarded the progress of science in the University, and, like the other scientific departments, chemistry had to struggle during many years.

In 1877 the Institute of Chemistry had its origin in a voluntary association of chemists united in the desire for the organisation of the profession and for improvement in the education and qualifications of those who intended to practise

as consultants. Sir Edward Frankland was the first president, and he was followed by Sir Frederick Abel; but it was during Odling's occupancy of the chair, and largely owing to his influence, that the charter was granted in 1885. Although it is vain to look in the Royal Society Catalogue of Scientific Papers for outstanding discoveries the result of experimental work under Odling's name, it should not be forgotten that he contributed several very important articles on theoretical subjects to Watts's "Dictionary," and among them one on atomic weights, in which he came very near the discovery of the periodic law now always associated with the name of Mendeléeff.

In 1872 Odling married the only daughter of Alfred Smee, F.R.S., inventor of "Smee's battery," and formerly surgeon to the Bank of England, and by her he left three sons. Mrs. Odling died about four years ago, and this loss seems to have affected her husband seriously; however, when visited in January only a few weeks before his death his mental activity seemed undiminished, and he was ready to talk of old times. W. A. T.

THE death of MR. C. GROVER, of Rousdon, Devonshire, on February 16, removes from the list of variable star observers a notable figure. There are now thirty-five years' observations made with the same instrument (a 6·4-in. refractor by Merz and Cooke, with low-power eye-piece of 25 by Steinheil) by the same observer on the same plan, and with remarkable regularity and continuity. The first half of these observations were collected and discussed in vol. lv. of the R.A.S. Memoirs, but an equal contribution can now be added with a natural termination. This work was planned by the late Sir Cuthbert Peek, who took a personal share in its inception. Since Sir Cuthbert's death in 1900 it has been continued by his son, Sir Wilfred Peek. Mr. Grover would have been seventy-nine on March 7, and continued at his regular work until the very day preceding his death. There can seldom have been a more single-minded piece of astronomical work.

THE death of MR. JOHN CLARKE HAWKSHAW on February 12 is recorded in *Engineering* for February 18. Mr. Hawkshaw, who was eighty years of age at the time of his death, was the son of the late Sir John Hawkshaw, whose name is associated with so many important engineering works. Mr. Hawkshaw was associated with the construction of the Albert Dock, Hull, the Severn Tunnel, etc., and assisted his father in investigations with the Channel Tunnel and many other schemes. He was elected a member of the Institution of Civil Engineers in 1867, became member of council in 1889, and held the office of president in 1902–3.

IT is announced in *Science* for February 4 that MARY WATSON WHITNEY, emeritus professor of astronomy, and from 1889 to 1910 director of the observatory of Vassar College, New York State, died on January 20, aged seventy-three years.

Notes.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Dr. W. E. Agar, Dr. F. W. Aston, Prof. W. L. Bragg, Dr. W. T. Calman, Dr. A. H. Church, Prof. G. Dreyer, Prof. W. H. Eccles, Dr. J. C. G. Ledingham, Mr. C. S. Middlemiss, Prof. K. J. P. Orton, Dr. J. H. Parsons, Prof. J. C. Philip, Dr. A. A. Robb, Sir E. Tennyson D'Eyncourt, and Mr. G. Udny Yule.

THE Royal Society administers two funds, the Gore Fund and the Trevelyan Fund, which have been bequeathed to the society for the promotion of scientific research. There is a balance in hand of about 200*l.*, and the president and council would be glad to consider applications for the whole or part of this balance. Applications should be sent to the Secretaries of the Royal Society, Burlington House, London, W.1, before April 15, stating the sum asked for and the way in which it is proposed to spend it, and enclosing any references or other documents the applicant may think fit.

THE combined meeting of organising committees of the Sections of the British Association, held at Burlington House on Friday last, February 25, was so helpful in many respects that it might very well become an annual event. The meeting was called to consider various suggestions as to the number and grouping of Sections, presidential addresses, and other subjects discussed in the recent correspondence in NATURE and elsewhere, and also to facilitate the arrangement of joint programmes between two or more Sections for the annual assembly at Edinburgh in September next. At the general session it was agreed that the number of Sections should not be reduced, but that voluntary grouping for the consideration of subjects of common interest was desirable. The council (through the general officers) was empowered to fix hours of addresses and discussions, and the view was approved that the oral delivery of presidential addresses should be optional, as well as that the addresses themselves might be used to open discussions. It was also decided that the council should invite the recorders of Sections, or their nominees, to be present at meetings of council when presidents of Sections are elected. Organising committees will thus, through their representatives, be able to put forward their views as to new sectional presidents. Several important joint discussions were arranged for the forthcoming meeting, among them being one between the Sections of Physics and Chemistry on Langmuir's theory of the atom, and another between the Sections of Economics, Education, and

Psychology on vocational education and psychological tests. We hope shortly to be able to give further particulars of these and other joint discussions which promise to make the Edinburgh meeting both distinctive and of great interest to a large intellectual public.

SIR WILLIAM J. POPE has been elected Membre d'Honneur of the French Chemical Society.

THE PRINCE OF WALES has become president of the Royal Commission for the Exhibition of 1851 in succession to Prince Arthur of Connaught.

ANNOUNCEMENT is made that summer time is to begin this year during the night of April 2–3 and end on October 2–3. Last year summer time began on March 28.

THE council of the Chemical Society has awarded the Longstaff medal to Prof. J. F. Thorpe. The presentation will be made at the annual general meeting on March 17.

BY a decree dated December 17, 1920, the centesimal system of angular measurement has been adopted in Sweden for land surveying, the hundredth part of a right angle being indicated by 1°.

THE Mackenzie-Davidson memorial lecture of the Electro-Therapeutics Section of the Royal Society of Medicine will be given at 8.30 p.m. on Friday, March 18, at the rooms of the society, 1 Wimpole Street, W.1, by Prof. W. D. Halliburton, who will take as his subject "Physiological Advance: The Importance of the Infinitely Little."

THE sixth Guthrie lecture in connection with the Physical Society of London will be delivered at 5 o'clock on Friday, March 11, at the Imperial College of Science and Technology by Prof. A. A. Michelson, of Chicago. The subject will be "Some Recent Applications of Interference Methods." To this meeting visitors are invited.

A DISCUSSION on problems of seismology will be held in the rooms of the Royal Astronomical Society to-morrow, March 4, at 5 p.m. The chair will be taken by Prof. H. H. Turner. Prof. Horace Lamb will open the discussion, which will be continued by Dr. G. W. Walker, Mr. R. D. Oldham, and Mr. J. J. Shaw.

WE regret to learn that Prof. William A. Bone, professor of chemical technology at the Imperial College of Science and Technology, South Kensington, whose work on fuel is so well known, underwent a serious operation on Thursday last, and is at present passing through a critical period of recovery. He is, therefore, compelled to suspend all his scientific and public engagements for some time.

THE British Research Association for Liquid Fuels for Oil Engines Industry has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of the committee engaged in the establishment of this association is Mr. Percy Still, 19 Cadogan Gardens, S.W.1.

AT the last meeting of the Geological Society Mr. C. Carus-Wilson exhibited a specimen of stalagmite from a cave in the Cheddar district containing the preserved impressions of moths' wings. Each layer of the stalagmite shows a number of these fossils, and Mr. Carus-Wilson thinks they may have been rejected by bats while feeding. The stalagmite had formed on a ledge at one side of the cave about 60 ft. from its mouth. Many other limestone caverns might yield similar fossils if searched.

Science for February 4 announces that the John Fritz gold medal for notable scientific and industrial achievement has been awarded to Sir Robert Hadfield, inventor of manganese steel and leader of the British steel industry. The award of the medal has been authorised unanimously by the sixteen members of the committee representing the national organisations of civil, mechanical, mining, metallurgical, and electrical engineers. The medal was established in 1902 in honour of John Fritz, ironmaster of Bethlehem, Pennsylvania.

A SWEDISH expedition, under the leadership of Dr. Otto Nordenskjöld, is at present engaged in exploration in the central and southern Cordilleras of South America. The *Geographical Journal* for February states that Dr. Nordenskjöld, accompanied by Mr. A. Bäckman, Count S. de Rosen, and others, began work last autumn in the Sierra region south of Oroya and explored the little-known Perene River and Pangoa Valley. In December the expedition went south to Chile. Its destination was the Peñas Gulf and the region round San Rafael Lake. It is hoped also to ascend one of the glaciers to the inner mountain region. The expedition, which has received valuable assistance from the Governments of Peru and Chile, expects to return to Europe at the end of the southern summer.

THE *Times* for February 25 contains an interesting letter from the secretary of the China Inland Mission with regard to the great earthquake that visited the north-west provinces of China on December 16 last. The meizoseismal area covers a large portion of the provinces of Kansu and Shensi, and is not less than 200 miles long from north-west to south-east and about 150 miles wide. The centre of the area lies about 30 miles south-east of Pingliang. Even near Sichow, which is about 250 miles from the epicentre, the shock was strong enough to throw down houses and to bury the inmates in the ruins. The earthquake seems to have been a remarkable one, even among shocks of the first order of magnitude, especially as regards the great size of the area of destruction and the changes wrought in the superficial layer of the crust.

THE next summer meeting of the Institution of Electrical Engineers will be held in Scotland on June 7–10. The first two days will be spent in Glasgow, when visits will be paid to the new power station at Dalmarnock and to works and other places of interest. There will also be papers on that power station and on the hydro-electric power resources of Scotland. On

June 9 the party will proceed by special train to Fort William or Banavie (Inverness Canal), and on the following day a steamer will take the visitors down Loch Linnhe to Kinlochleven, where the hydro-electric installation of the British Aluminium Co. will be visited. In the afternoon the steamer will continue its journey southwards and land the party at Oban, where the visit will end on Friday evening, June 10. The journey to Fort William and thence to Oban will give an opportunity of seeing the most magnificent scenery of the Western Highlands.

A JOINT discussion on "The Failure of Metals under Internal or Prolonged Stress," to be held on April 6, is being organised by the Faraday Society, the Institution of Mechanical Engineers, the Institute of Metals, and the Iron and Steel Institute. Other institutions of engineers and shipbuilders are also participating in the discussion, which will occupy an afternoon and an evening session. The proceedings will be opened by Dr. W. Rosenhain, and the preliminary programme contains a list of sixteen papers on specific aspects of the subject, in which the chemical influences at work, the effects of stress at high temperature, corrosion, the mechanism of failure from internal stress, as well as particular points in relation to the failure of steel, brass, and lead, will be discussed. An exhibition of specimens will be held in connection with the meeting. Further information can be obtained from Mr. F. S. Spiers, secretary to the joint committee, 10 Essex Street, Strand, W.C.2.

THE Electro-Therapeutic Section of the Royal Society of Medicine and the British Association of Radiology and Physiotherapy have organised a congress to be held in London on April 14–16. Sir Humphry Rolleston will be president of the meeting, and Dr. G. Harrison Orton secretary-general. The honorary secretaries for general correspondence are Dr. S. Melville and Dr. Justina Wilson, and the sectional secretaries Dr. N. S. Finzi for radiology, Dr. G. Murray Levick for electrology, and Dr. C. V. MacKay for physiotherapy. A provisional programme of the meeting has been arranged which includes discussions and visits to the electrical departments of selected London hospitals. Abstracts of papers should reach the secretaries at the Royal Society of Medicine before March 24; communications may be written either in English or in French.

THE Teyler Society of Haarlem announces that a gold medal of the value of 400 florins will be offered in 1924 for a treatise dealing with the following investigations:—"Referring to the studies of V. Grégoire, which show that the nuclei of both animal and vegetable cells are built up of karyomeres, the society invites investigation into the nature of these organs, especially during the period of rest of the nuclei, and of their bearing on questions of heredity." Papers may be submitted in English, Dutch, French, or German (in Latin characters), and must be typewritten or written by someone other than the author; they become the property of the society, and the right to publish them in its Proceedings is reserved. The works should be sent under a pseudonym, and the author's name and address enclosed in a sealed envelope bearing the same pseudonym. Papers must reach the society on or before April 1, 1923, and should be addressed: aan het Fundatiehuis van wijlen den Heer P. Teyler van der Hulst, te Haarlem.

AN inquiry into the present-day problems connected with the spread and prevention of filarial diseases in the tropics, more especially as they affect Demerara and the West Indies, has been undertaken at the request of the Colonial Office by the London School of Tropical Medicine. Dr. J. Anderson and his laboratory staff sailed from England on February 24; Prof. R. T. Leiper, the leader of the expedition, and the other members, Dr. Vevers, Dr. C. U. Lee, and Dr. Khalil, will proceed by different routes during March. The whole party will meet in Demerara early in April. The expedition will be away for upwards of seven months. The sending of this expedition at the present moment is particularly opportune in view of the proposed Intercolonial Medical Conference which is to be held shortly at Georgetown, British Guiana, to consider the sanitary problems of the West Indies. The expedition has been made possible through the generous public support accorded to the appeal recently made by Lord Milner on behalf of the London School of Tropical Medicine.

IN a communication from the Decimal Association on the progress of the metric system of weights and measures, it is stated that since the war the system has made notable headway in many foreign countries which have not yet officially made it compulsory for use in trade. In China the system is already in exclusive use on the railways, and it is expected that the Government will adopt the metric units when standardising their weights and measures. Legislative proposals having for their object the exclusive use of the system for trade purposes are at present under consideration in the United States, Japan, and Siam. Our own Ordnance Survey Office has announced that on all small-scale maps an alternative scale of kilometres and tenths will be printed in addition to the scale of inches, and on all small-scale layer maps the metric heights will be added in whole numbers of metres. The Decimal Association urges the Government to abandon its attitude of passive permission of the metric system and to embark on a campaign of active encouragement, and adds that it appears inevitable that the metric units will ultimately become the world standards of weight and measure, and that the longer we delay its exclusive adoption the more difficult and costly will be the transition.

SIR HERBERT JACKSON, the retiring president of the Institute of Chemistry, in the course of his address at the annual general meeting on March 1, remarked that Government Departments and official authorities generally have shown more inclination in recent times than in the past to accord higher recognition to the services of men of science. The institute is taking part in many matters affecting the public life of the country where chemistry is concerned, and the annual report shows that chartered professional bodies of this character are able to render the State valuable

service. The greater consideration given to science by the Government is an encouragement to the coming generation of chemists to follow a career of essential and vital importance to the needs of the country. Sir Herbert Jackson added that it would probably be regarded as desirable at the present moment for the council of the institute, without taking part in politics, to give expression to its views on the grave importance of maintaining in this country industries on which not only the future development of our chemical industry and many allied industries depends, but also the outlook of a very large number of students of chemistry who are now in course of training. The institute is entrusted by its charter with securing the supply of well-trained chemists, but unless a great chemical industry is maintained there will be a very poor prospect for them. Mr. A. Chaston Chapman succeeds Sir Herbert Jackson as president of the institute.

THE dry weather experienced recently is occasioning a suspicion in some quarters that the wet years we have had may be followed by a period of drought. This is naturally of importance in London and largely populated centres. It is customary now to compare rainfall results with the new normals for the thirty-five years 1881 to 1915. Taking Greenwich observations for means of comparison, the annual results for the last ten years show an excess of rain in seven years on the thirty-five years' average (23·50 in.) and a deficiency in three years. Other stations in the Thames Valley generally support these results. The total rainfall at Greenwich for the ten years was 254·25 in. Looking at the Greenwich results for the last hundred years, the heaviest rainfall in ten years seems to have occurred in 1872 to 1881, when there were seven years with an excess, and three years with a deficiency, on the hundred years' normal (24·41 in.). The total rainfall for the ten years was 268·42 in. This was followed by a dry period continuing approximately for twenty years, from 1883 to 1902, during which there were seventeen years with a deficiency, and only three years with an excess, of rainfall. This single instance affords probably little proof for future guidance. The admirable Monthly Reports published by the Thames Conservancy and the Monthly Maps of the Thames Valley rainfall published by the Meteorological Office would afford better and more valuable data for inquiry, especially in connection with the water-supply for London.

IN a discussion on "The Use of Light as an Aid to Publicity" before the Illuminating Engineering Society on February 24 attention was directed to the indiscriminate use of bright lights in shop-windows and for illuminated signs, and the need for some form of co-ordination of such displays was emphasised. It was also remarked that the lighting of exhibitions, even those devoted to technical or scientific processes, is usually executed in a very crude manner without any scientific and organised plan. The use of light for directing attention to objects and revealing them to observers involves interesting optical problems, some of which were illustrated by a variety of luminous signs exhibited at the meeting. There was general agreement that the best effect is secured by adopting methods similar to those used in lighting the stage of a theatre, *i.e.* by concealing the actual light-sources from view. Capt. E. Stroud showed photographs of a number of shop-windows thus illuminated, and Mr. E. C. Leachman, who read a paper on illuminated signs, exhibited some striking pictorial transparency effects. A feature of these was the use of a new method of depositing colours on specially prepared linen, by the aid of which good transparency of the coloured surfaces, high luminosity, and vivid contrasts of light and shade were obtained. It was remarked that the device of illuminating a translucent picture from behind opened up new possibilities in art, as painted pictures lighted in the usual way from the front appear flat in comparison. Other forms of signs made use of ingenious colour effects. One of the most interesting devices was the sign shown by Mr. E. T. Ruthven Murray, in which light is distributed throughout the interior of a sheet of plate-glass by total internal reflection, so that white letters stencilled on the back appear strikingly illuminated, the source of light, a tubular lamp, being completely concealed from view.

THE publication of the first number of the *Antiquaries' Journal* makes a new departure in the history of the Society of Antiquaries, an attempt to bring before a wider public the results of its investigations, which have hitherto lain buried for many readers in the long series of its Proceedings and "Archæologia." The character of this the first example of the new publication ensures its success. Perhaps the most important paper is the interim report by Lt.-Col. W. Hawley on his excavations at Stonehenge conducted during the work undertaken for the preservation of the monument by H.M. Office of Works. Full details of the results of the digging required for the re-erection of some of the monoliths are given, but in the absence of a scientific commentary these may be regarded only as material for examination by experts. The most interesting new points are the excavation of the pits marked on Aubrey's map of 1606 and the statement by Dr. H. H. Thomas, Petrographer to H.M. Geological Survey, who has arrived at the important conclusion that with regard to the majority of the blue stones "their ultimate source lay in the Prescelly Mountains and in the boulder-strewn area to the immediate south-east. All possible proximate sources, however, must, of course, be investigated, but he felt that the idea of Pembrokeshire boulders being carefully selected from practically all other rocks, and stranded on the high ground of Salisbury Plain by glacial action, was contrary to all sound geological reasoning; and that such an assemblage of stones, of which so many were of the same type, pointed to human selection and conveyance from a distance."

THE Journal of the Royal Society of Arts for January 28 contains a paper by Dr. C. S. Myers on industrial fatigue. No satisfactory definition or test of industrial fatigue is known, though various suggested methods are discussed. Dr. Myers analyses the work curve, and shows that it is compounded of at least five different factors—fatigue, practice, incite-

ment, settlement, and spurt—and in most factories probably of more. Examples from some of the publications of the Industrial Fatigue Research Board show the disadvantages of the ten-hour as against the eight-hour working day, and also the improvement resulting from suitably arranged rest-pauses. The author points out, however, that a certain amount of fatigue is not only inevitable, but also beneficial; it is when the fatigue cannot be dissipated by rest that the condition is serious and the work suffers. The difference between the work of a machine and that of a human being is emphasised; it is unnatural for the latter to maintain a uniform output hour by hour. It is also necessary for industry to recognise the importance of individual differences among workers. Dr. Myers concludes by referring to the work of the Industrial Fatigue Research Board and of the National Institute of Industrial Psychology, which latter continues and develops the more general work of the Board for special firms. Although these bodies have been working but a short time, their researches have clearly shown the very complex nature of industrial fatigue problems and the urgent necessity for scientific investigation by impartial workers.

SIXTY-ONE pages on the growth of the antenna in termites might be thought disproportionate, but Mr. C. Fuller has made a really interesting study (Annals of the Natal Museum, vol. iv., p. 235, November, 1920). The number of segments in the antenna has, as in other insects, been held to distinguish various species, and even the length of the basal segment, numbered III., has been taken as diagnostic. But when soldiers of one species from a single colony were found with antennæ ranging from seventeen to nineteen segments, this practice clearly called for reconsideration. It now appears that the segments are produced by separation from this segment III., and normally two at a time. The two segments of a pair may fuse or the proximal element may not be separated from III., and in this way arise antennæ with an odd number of segments. The relative length of III. depends on the number of segments that have been separated from it. The variation of number is governed by a general tendency to reduction throughout the group and by various environmental factors, of which nutrition is the most important. All antennæ, even in the adults of the most fully developed species, show within segment III. unseparated segments, and are therefore arrested organs. This gradual and continuous response to the environment in a segmented organ has an obvious bearing on theories of evolution, and Mr. Fuller's paper deserves study by general biologists. Fortunately, it is well arranged and well written. But we do not like the words "quiescency" and "monolocular"; we do not understand how "acrogenous" can apply to growth in a proximal region; and we protest against the use of the anatomical term "joint" when "segment" is intended.

MESSRS. NEWTON AND CO., LTD., 37 King Street, Covent Garden, W.C.2, have recently prepared a set of lantern-slides for a lecture on "Wireless Telegraphy" dealing more particularly with the Elwell-Poulsen system. The slides, many of which are from hitherto unpublished photographs, are accompanied by a full set of notes, which provides alternative methods of treatment for audiences of varying degrees of acquaintance with the subject.

Our Astronomical Column.

THE DATE OF EASTER.—A Bill to fix the date of Easter as the second Sunday in April has been introduced into the House of Lords by Lord Desborough. This Bill may serve to focus attention on the matter, but it is scarcely likely of itself to do more, for the question is one that calls for international and ecclesiastical co-operation, as was recognised by the Astronomical Union when it appointed Cardinal Mercier to preside over the Commission on Calendar Reform. Isolated action would only increase the present inconvenience, and obviously a Parliamentary decision would not be accepted by a considerable section of the community in such a matter as the alteration of the date of a religious festival.

ANCIENT STAR MAPS.—Dr. M. Schönfeld contributes an article to *La Nature* for February 5 on prehistoric astronomy in Scandinavia. He reproduces some old rock sketches found at Bohuslän, Venslev, and Dalby. They appear unmistakably to be intended to represent several notable star groups, Ursa Major being repeated three or four times, while Boötes, Virgo, and Cassiopeia are also more or less roughly delineated. It would appear that these designs are not *very* many thousands of years old, as several sketches of men and animals accompanying the star groups indicate that the constellations were already mapped out substantially as we now know them. The Bull, Archer, Great and Little Dog, and the ship Argo can all be traced. Moreover, Arcturus moves through 0·6° in 1000 years, and while the sketch of Boötes is too rough to assign a date to it with any accuracy, we can at least say that it is unlikely to have been drawn more than 10,000 years ago. Dr. Schönfeld claims that different sketches represent the sky at different seasons of the year, but he seems to overlook the fact that unless we know the approximate date of the drawings we may be several months in error through the effects of precession.

THE 1920 OPPOSITION OF MARS.—*Popular Astronomy* for February contains very interesting drawings and photographs of Mars made at Flagstaff Observatory last spring, together with articles by E. C. Slipher and G. H. Hamilton. The aspect of Syrtis Major was very unusual, considerable sections of it being covered by a white veil, apparently cloud or mist. It was noted that this white region was not surrounded by a dark band, as was the polar cap; and it is concluded that the latter band is not illusory, as some have contended. Mr. Hamilton notes that the Syrtis appeared normal until March 8, and was then modified in two different ways. Besides the partial covering by white cloud, the south-eastern edge of the Syrtis appeared to fade and merge into the adjacent desert. Both Mr. Hamilton and Mr. Slipher refer to the veiling by mist near the limb which is a familiar feature, but at the recent opposition the mist seems to have persisted an unusually long time after sunrise.

A New Deposit of Cobalt Ore.

THE development of new uses of metallic cobalt has established a demand for this commodity, which until recently was a metal of comparatively small account. When the production of metallic cobalt as a by-product commenced a few years ago, it was necessary to initiate research into the possible uses of the metal before an increased demand could be created. The position now is that the uses of cobalt are many and various, and the question is: Where are we to find the supplies that are likely to be necessary to meet the future demand for the metal?

In these circumstances it becomes important to put on record any discoveries of new occurrences that give any promise of development to meet the world's requirements, and in this connection a report by the Queensland Government Geologist recently received at the Imperial Mineral Resources Bureau concerning a high-grade deposit near Selwyn, in the Cloncurry district of Queensland, is of special interest. The locality is approximately 19 miles south of Selwyn, the nearest railway station, which is 71 miles from Cloncurry. By track it is about 5¾ miles south of Mount Dore (located on Queensland 4-mile map-sheet 120) and 1–2 miles west of the Mort River.

The cobalt ore occurs at the contact of diorite (apparently a dyke about 5 chains wide) and schists, the latter belonging to the Cloncurry series of supposed Silurian age. The schists have a strike of 5° west of north, and dip easterly at angles of 74° to 80°. They form noticeable outcrops on the area, and associated with them at a few chains from the diorite are several prominent white quartz outcrops conforming to the strike of the country, and to all appearances barren.

The workings at present consist of four shafts. No. 1 is 23 ft. deep, No. 2 27 ft., No. 3 20 ft., and No. 4 20 ft. The distance between No. 1 and No. 4 shafts is 300 ft.

The ores consist of cobaltite (sulpharsenide of cobalt, containing 35·5 per cent. of cobalt) and erythrite or cobalt bloom (hydrous arsenate of cobalt, containing when pure about 29 per cent. of cobalt). A picked sample of cobaltite from this lode recently assayed for the Department of Mines gave the following composition:

	Per cent.
Arsenic	40·2
Sulphur	15·8
Cobalt	33·1
Nickel	nil
Iron	2·1
Insoluble (chiefly SiO_2)	8·3
	99·5

The workings are not extensive, and the following notes are descriptive of what work has been done in prospecting:

No. 1 Shaft.—This is the most southerly shaft on the lode. At the top the lode is 2 ft. 6 in. wide, and at the bottom (23 ft. deep) it has narrowed to 12 in. On the hanging wall there is a seam of white clay up to 4 in. thick. Where this is removed the hanging wall is pink-stained with "bloom." The footwall has a smooth surface indicating a fault plane. The ore here consists of highly altered rock with veins of erythrite and small lenses of sulphide.

An average sample chipped across the lode on both sides of the shaft (1 ft. on the north and 6 in. on the south) near the bottom gave the following analysis (Assay No. 515/7):

Gold	9 grains
Silver	trace
Metallic cobalt	17·4 per cent.
Metallic nickel	nil
Arsenic	9 per cent.

No. 2 Shaft.—This shaft discloses a lode formation 5 ft. wide regularly to the bottom, depth 27 ft. Both walls are well defined. On the footwall is a seam of solid sulphide ore 2–9 in. thick, and on the hanging wall there is a very narrow seam of sulphide. Between two walls the lode material consists of a siliceous indurated gangue, much jointed, with erythrite and sulphide veins coating all the joint-faces. Cobaltiferous wad is present in small quantities in the lower half of the shaft, associated with the two other minerals. A grab sample from the ore-paddock at this shaft returned (Assay No. 516/7):

Gold	19 grains
Silver	trace
Metallic cobalt	12 per cent.
Metallic nickel	nil
Arsenic	16·5 per cent.

The ore-paddocks at this shaft are estimated to contain 50 tons of ore, averaging, as above, approximately 12 per cent. of cobalt.

No. 3 Shaft.—The lode varies from 2 ft. to 3 ft. in thickness. On the footwall is a very thin seam of scheelite. The lode is schist much altered and replaced by veins of erythrite, generally not exceeding 1 in. thick. There are small lenses of sulphide close to the footwall.

No. 4 Shaft, the most northerly, has turned out the most massive sulphide ore. The lode is from 2 ft. to 3 ft. wide, and consists of soft, decomposed schist largely replaced with erythrite. It contains a central string of solid sulphide ore in the form of lenses almost constituting a single vein. The lenses vary from 8 in. to 18 in. in width. Analyses of the following samples were as follows:

Average Sample taken across Lode in No. 4 Shaft (Assay No. 513/7).

Gold	2 dwt. 19 gr.
Silver	18 dwt.
Metallic cobalt	19·5 per cent.
Metallic nickel	nil
Arsenic	28·3 per cent.

Average Sample of Paddock of Oxidised Ore (Assay No. 514/7).

Gold	trace
Silver	trace
Metallic cobalt	10 per cent.
Metallic nickel	nil
Arsenic	12 per cent.

The ore-paddock near this shaft is estimated to contain 32 tons of picked high-grade sulphide ore, the approximate content of cobalt equalling 25 per cent. There are also about 10 tons of lower-grade oxidised ore consisting mostly of erythrite in a schist gangue assaying 10 per cent. of cobalt.

It is estimated that in prospecting the lode between 130 and 140 tons of ore have been raised, of which 92 tons represents ore in paddocks; 30 tons of the latter is approximately of 25 per cent. grade and the balance of 10–12 per cent. grade.

The lode is regular in its trend, almost following a straight line for at least 300 ft. The walls in places

are well defined, and both these features indicate that there has been movement along the contact, so that it may be classed as a fissure lode on an igneous contact. It is certainly too regular in strike to consider it a replacement along what superficially appears to be rather regular igneous contact. Where the gangue is extremely hard indurated schist this is much jointed or broken, further pointing to a settling movement along the contact planes. The lode underlies 75°–80° easterly, which is the dip of the schists on the hanging walls. The gangue in the lode consists of diorite in various stages of alteration, soft weathered schist, and hard indurated schist. Where the last-named occurs replacement appears to be confined to the fracture-faces, which are coated with cobaltite in process of oxidation to erythrite.

A few chains north of No. 4 shaft there are some old abandoned workings on the contact. These were worked for copper, and there is a good deal of copper carbonate associated with the mullock. With the copper occurs a vein of scheelite 2–4 in. wide, from which well-developed crystals of that mineral have been obtained. Although so closely contiguous, there is no appearance of cobalt stains.

In the diorite dyke in juxtaposition to the cobalt lode there is a quartz outcrop running at right angles to it which contains cobaltiferous wad as well as jasper-brown iron ore. Although it does not meet the cobalt lode at the surface, it has possibly a genetic relationship to the cobalt lode, and it is suggested that it may have been a channel of supply, thus accounting for what, at the present time only, appears a definite localisation of the cobalt in the contact lode. A sample of the wad from this outcrop contained:

Metallic cobalt	5·2 per cent.
Metallic nickel	nil
Arsenic	0·9 per cent.

It is very desirable, however, that the whole of the diorite contact should be prospected, particularly the eastern contact, on account of copper carbonates, scheelite, and cobalt ores having been already found along it.

The Study of British Roses.

THE study of our British roses has been rendered increasingly difficult by successive attempts to classify the numerous forms—species or varieties—in a satisfactory system. The late Mr. J. G. Baker in his "Monograph of British Roses" in 1869 recognised thirteen species and a moderate number of varieties. In the "London Catalogue of British Plants" (1908) some of Baker's varieties are raised to specific rank, and twenty-five species and a large number of additional varieties are recognised. Wolley-Dod's "List of British Roses" (1911) included about 170 names, but in his "Revised Arrangement" recently published in the *Journal of Botany* the number of names having full specific rank is reduced to eighteen, the author remarking that most of the very detailed descriptions of Déséglise and other specialists can scarcely be other than those of an individual bush or specimen which cannot be completely matched by any other.

The present position is discussed in the *New Phytologist* (vol. xix., Nos. 7 and 8) by Mr. J. R. Matthews, who considers that only by culture, combined with cytological study, will it become possible to determine finally the genetic relationships of the numerous micro-species into which old, well-known species like *Rosa canina*, Linn., have been split. The study of external form has so far failed to give a satisfactory solution of the problem, and the anatomical method followed by Parmentier has not proved more successful. Several hybrids—that is, crosses—between distinct species have been recognised among British roses, and it is not improbable that the difficulty in classifying the genus may be largely due to hybridisation and segregation, complicated, it may be, by rehybridisation. Hybrids between closely similar parents would be difficult to diagnose, and in actual practice would, as a rule, be considered distinct species or varieties; and it is suggested that a large portion of the total number of named varieties of roses has arisen in this way.

The work of Jeffrey on hybridism in the Rosaceæ indicates that certain recognised species are, from the study of their pollen, in reality concealed hybrids (crypthybrids), and Miss Cole more recently from the study of the pollen in numerous roses concludes that the great majority of so-called species are really of hybrid origin. There is no experimental evidence to show whether these species-hybrids segregate or remain stable; but presuming segregation to occur in the genus Rosa, we might expect to find a large number of visually distinct forms showing various combinations of Mendelian unit-characters, such as hairiness, leaf serration, glandularity, glaucousness, etc.

Mr. Matthews attempts a theoretical analysis of some of the British species of roses on the basis of a few separate characters such as these. The species selected are the aggregate species generally recognised by systematists, and the author suggests that the numerous sub-species and varieties of these aggregates which have been described represent some of the various combinations of unit-characters which might be expected to result from the process of segregation. The argument is confessedly entirely hypothetical, and the author emphasises the importance of experimental work to establish the hypothesis.

Commerce and Customs of Papua.[1]

IN his Report on the Territory of Papua for the year ending June, 1919, the Lieutenant-Governor, the Hon. J. H. P. Murray, shows that, as in so many other parts of the world, the scarcity and irregularity of shipping facilities are acting prejudicially to the progress and development of the Territory. This is especially indicated by the decrease of exports upon which the prosperity of the country mainly depends. Rubber alone showed an increase, but the quantity is as yet small (207 tons as compared with 144 tons in 1918). Another important vegetable export, copra, has decreased (2598 tons as compared with 3189 tons in 1918). Native-made copra forms a large proportion of the output, and, owing to variation in the production, this does not increase steadily like the plantation product. The production of sisal hemp has also decreased, whilst the value of all the crops has been much reduced by a fall in prices. The

[1] "Commonwealth of Australia. Papua. Annual Report for the Year 1918–19." Pp. 117+2 pls. (Printed and Published for the Government of the Commonwealth of Australia by Albert J. Mullett, Government Printer for the State of Victoria.)

export of the chief minerals, gold and copper, has decreased, but there are good prospects of development and increased production at Port Moresby and Misima Island. The value of the gold was 26,766*l.* in 1919 as against 33,512*l.* in 1918. Copper was worth 11,537*l.* in 1918, but only 1653*l.* in 1919.

The actual revenue of the Territory, including a grant of 30,000*l.* from the Commonwealth of Australia, amounted during the year to 103,120*l.* The expenditure was 102,961*l.* Thus a surplus of 18,778*l.* in 1918 was increased by about 159*l.* to 18,937*l.*

The European population was 1007. Coloured persons other than Papuans were 304, of whom 217 were mission teachers. There were also 340 police and 821 village constables of various races. During the year 8610 native labourers were recruited, to whom more than 40,000*l.* was paid in wages.

The actual native population is uncertain. A quarter of a million is suggested by the Acting Medical Officer. In some districts the number is increasing, but around Port Moresby the physique of the natives appears to be deteriorating through the adoption of European food and clothing. In a supplement to the report the Rev. J. B. Clark, of the London Missionary Society, gives a hopeful account of the progress of the natives. Boys leaving school become telephone operators and clerks, and some of the native churches are capable of self-government. The relations of the natives with the Government have been, on the whole, satisfactory. A few affrays and murders have taken place in remote districts, but there has been a general prevalence of respect for law and order. An incident in the Chirima district of the Mambare Division is typical of dealings with the natives. The attempt of a patrol to arrest a native led to an attack in which another native was killed and a woman and a boy were wounded. The natives were afterwards pacified by the Resident Magistrate of the Kumusi Division. The pacification involved some difficulty and risk, as the natives took to the bush and refused to parley unless the officers, Messrs. Blyth and Fowler, went to them unarmed and alone. The officers took the risk, and after a conference the confidence of the natives was restored.

A valuable scientific section of the report is found in the supplements contributed by the Resident Magistrates and patrol officers, the Medical Officer, the Government Geologist, and the Agricultural Expert.

A paper of considerable ethnological interest by the late W. Beavers (*cf.* NATURE, February 19, 1920) is also included. It deals with the use of emblems or insignia of man-killing among certain tribes of the north-western part of Papua. A preface gives an account of the ceremonious reception of the man-killer by his village, and of his life on his return. The insignia consist of various decorations of shell-rings, feathers, dog-teeth, and similar articles. There are also other distinctions not of a material nature, such as taking the name of the individual slain, prohibition of his flesh to the slayer, skull trophies, and mutilations. A further account describes the *Kortopo* ceremony by which the privileges of the man-killer are passed on to others. The custom is now decadent, and the slaying of a fat pig is sufficient justification for the wearing of the emblems.

The polyglot character of the tribes of Papua is shown by an index of the vocabularies of native dialects contained in the annual reports from 1889 to 1918. There are more than 450 titles. The present report increases them by fourteen.

SIDNEY H. RAY.

Ancient Egyptian Survivals in Modern Egypt.

AN interesting lecture upon the above subject was delivered on behalf of the Egypt Exploration Society at the rooms of the Royal Society, Burlington House, on February 23 by Prof. C. G. Seligman.

Two classes of survival from ancient Egypt may be distinguished, namely, (1) beliefs and (2) certain technological objects and processes. Each group embraces, on one hand, survivals *in situ*, such as certain beliefs connected with the calendar, and a ceremony in which a sacred boat takes a prominent part; and, on the other, examples from other parts of Africa in which Egyptian customs, often modified by later cultural waves, have persisted for a longer or shorter period. As examples may be cited certain medieval graves of Senegal, and probably the funeral customs of a number of tribes of Equatoria, as well as the belief in multiple souls found in the Southern Congo and West Africa.

A striking example is found in the persistence of old beliefs attached to certain days. In the Sallier papyrus, which dates from the time of Rameses II., or possibly of his successor, Athyr 19th is marked as one of the days "to beware": "storms are engendered in the skies; do not travel on the river neither up nor down; do not . . . at all on this day." In a modern calendar for 1878 the instructions for Zu'l-Heggeh 4th, which corresponds to the Coptic Hatour, *i.e.* Athyr 19th, is: "Avoid travelling on the Mediterranean." Thus we have persisting for some 3500 years the tradition that this day is unlucky for travellers.

Another interesting example mentioned by Prof. Seligman was that of a boat which is kept at Luxor, at the present day on the roof of a mosque, but a few years ago suspended in a tree. At stated times the boat is brought down, decorated with green branches, placed upon a cart, filled with children, and taken in procession round the town. There are three boat processions in Luxor every year, one to commemorate the birthday of Abu'l Heggag, the patron saint of Luxor, and the others on the birthday of the Prophet and the beginning of Ramadan.

These beliefs and ceremonies are of interest, not only because the period over which they have persisted is longer than that bridged by the host of beliefs and practices that constitute the folk-lore of other peoples, but also because it is possible to adduce perfectly definite evidence of their direct continuity over a very much longer period of time. The interest of the boat ceremony is even greater; Prof. Seligman thought a fairly good case could be made out for a number of boat ceremonies still performed in the East—*e.g.* one he had himself witnessed in Ceylon—having originated in Egypt and been carried eastward by Islam, just as was the Malay alphabet.

University and Educational Intelligence.

CAMBRIDGE.—Trinity College has offered to establish a prælectorship in geodesy if satisfactory arrangements are made for the institution in the University of a school for research in that subject. This is a very welcome move forward in a scheme which has been under consideration for some time to found a centre of geodetic teaching, and ultimately a Geodetic Institute, at Cambridge.

It is proposed to offer a diploma in hygiene which will suit the needs of medically qualified students of public health whose qualification is foreign and not registrable in Great Britain.

Grants have been made for the Gordon Wigan Fund towards plant-breeding, museum cases for insects, standard slides for petrology, and a solar radiation recorder for the botanical school. A recommendation is put forward to increase the value of the Balfour studentship from 250*l.* to 300*l.* a year.

THE London County Council Education Officer announces that a lecture on "Chemical Technology" will be given by Dr. M. O. Forster at Salters' Hall, St. Swithin's Lane, E.C.4, on Saturday, March 5, at 10.30 a.m.; and one on "The Romance of Science" by Sir W. H. Bragg at University College, Gower Street, on Tuesday, March 15, at 6 p.m.

IN an answer to a question concerning the London University site, the Chancellor of the Exchequer has made the following statement:—"In October last the University of London accepted the offer made by the Government in the preceding April of a site behind the British Museum and the site has been purchased. For the funds required for building the University headquarters the University must look primarily to private generosity, but it will be open to the University Grants Committee to supplement local contributions if the funds at their disposal allow." The purchase price of the site is 425,000*l.*

THE University of Melbourne has issued a statement with reference to an important lectureship and demonstratorship just established in natural philosophy. The lecturer will deliver the lectures in natural philosophy to medical students, and be generally responsible for the organisation of the teaching of this part of the work of the natural philosophy department. He will be appointed in the first instance for a period of five years, the appointment to date from March 1, 1922. The salary of the lecturer will be 750*l.* per annum, payable monthly. Candidates should not be above thirty-five years of age, and applications for the post should be lodged with the Registrar, University of Melbourne, by April 15 next. Facilities for original research in physics will be given. The Grayson gratings (see Proc. Roy. Soc. Vict., September, 1917) were ruled in a workshop of the natural philosophy department of the University.

A COURSE designed to meet the needs of qualified medical practitioners who may wish to obtain the diploma in public health of the Royal Colleges of Physicians of London and Surgeons of England has been arranged by the committee of the Technical College, Bradford, and the Health Committee of the City Council. For this purpose the Technical College has recently been placed upon the list of recognised institutions by the Royal Colleges. The proposed course will extend over twenty-five weeks, and include lectures and laboratory work in bacteriology and pathology and in chemistry. In connection with the course in bacteriology, Dr. W. Campbell has been appointed lecturer in bacteriology and the pathology of industrial diseases, and Dr. R. Cecil Robertson assistant lecturer and demonstrator in serology and immunology in the college. The course in chemistry will be under the direction of the head of the chemistry department of the Technical College (Dr. R. D. Abell). The recognition of the college for post-graduate work of this nature marks an important point in the development of the work of the college.

THE announcement that the Rockefeller Foundation intends to assist the medical schools of Central Europe is yet another step in the fulfilment of its purpose "to promote the well-being of mankind throughout the world." A programme is announced which provides for assistance in the rehabilitation of scientific equipment for medical purposes, for aid in furnishing medical journals to universities, and invites the authorities of the Medical School of Belgrade University to study medical education in England and America as guests of the Foundation. These decisions are the result of investigations into medical conditions in Central Europe made by representatives of the Trust, who reported that, with the exception of Austria, all the countries in this region are suffering from a shortage of physicians; there are only nine medical schools of repute to provide medical men for some 75,000,000 people. Belgrade is regarded as one of the strategic points in a medical campaign, so the invitation to study English and American methods has been given to the men who are responsible for its development; they have also been authorised to recommend candidates to the Foundation for fellowships for specialised post-graduate medical study. Germany is not included in the scheme, for she is considered to be adequately supplied with well-equipped medical schools. The International Health Board of the Rockefeller Foundation has come to an agreement with the Government of Czecho-Slovakia whereby the latter will borrow the services of a competent American public health administrator, and co-operate with the Board in the development of a national public health laboratory service, in the provision of fellowships for Czechs for public health training, and the dispatch of a Czech Commission to study public health administration in England and America. Nine medical men have already been awarded fellowships, and five members of the Commission from the Ministry of Hygiene have arrived in America as guests of the Foundation.

IN an address delivered in September last to the Old Students' Association of the Royal College of Science (Lamley and Co., South Kensington, S.W.7, price 2*s.* 6*d.*), Prof. H. E. Armstrong recalled his early training at the Royal College of Chemistry as it existed in 1865 at the close of Hofmann's career as professor in that institution. The freedom of choice of study left to an independent student of those days was contrasted with the examinational restraints imposed at present on candidates for university degrees. The lecturer referred to his later studies at Leipzig under Kolbe, in the golden era of German *Lern-* and *Lehr-freiheit,* and to his early teaching experiences at the London Institution. In 1879 Prof. Armstrong entered the service of the City and Guilds of London Institute, and thus became the founder successively of the chemical departments of the Finsbury Technical College and the Central Technical College. An intimate knowledge of the educational requirements of London extending over a period of fifty years leads the lecturer to the conclusion that the Imperial College must be autonomous, and that its functions should be restricted to the physical and mathematical sciences. Conversely, University College should be constituted as an Imperial College of Biological Science and Technology dealing with the special requirements of biology. It is suggested further that King's College should become an Imperial College of Arts and Economics. The three colleges thus reconstituted should be federated in one Imperial university. The social needs of the new university in regard to playing-fields would be met by establishing the Arts College on a country site such as at Kenwood. Students' hostels would be required at the urban centres. Each college should be granted the power to confer its own degrees, but the federal scheme should be sufficiently elastic to leave a student free to attend courses at a college other than his own so that his studies "could be as broad as his heredity would permit."

Calendar of Scientific Pioneers.

March 3, 1702. Robert Hooke died.—One of the earliest and most vigorous members of the Royal Society, Hooke was Gresham professor of astronomy. He constructed the first Gregorian telescope, first applied a spiral spring for the regulation of watches, pointed out the real nature of combustion, and proposed to measure the force of gravity by means of a pendulum. He died in the old Gresham College, and is buried in St. Helen's Church, Bishopsgate.

March 3, 1808. Johann Christian Fabricius died.—Professor of natural history at Copenhagen and then at Kiel, Fabricius by his writings exercised great influence on the development of entomology.

March 3, 1879. William Kingdon Clifford died.—A brilliant mathematician and thinker, Clifford died at the age of thirty-three while occupying the chair of applied mathematics in University College, London.

March 5, 1827. Pierre Simon, Marquis de Laplace died.—The son of a poor farmer of Normandy, Laplace went to Paris at the age of eighteen. There he was befriended by D'Alembert, and speedily rose to a high position among the group of distinguished men of science who adorned France during the Revolutionary period. An astronomer, physicist, and mathematician, his "Mécanique Céleste," published in five volumes between 1799 and 1825, is regarded as one of the noblest monuments of human genius. His tomb is in the Père Lachaise Cemetery, near that of Molière's.

March 5, 1827. Alessandro Volta died.—Born in Como in 1745, Volta was for twenty-five years professor of natural philosophy at Pavia. His invention of the voltaic pile was made in 1799, and the following year he communicated his discovery through Sir Joseph Banks to the Royal Society. So great was the interest raised by Volta's invention that Napoleon called him to Paris in order to see the experiments. At the Centenary Exhibition at Como in 1899 Volta's books and papers and much of the apparatus he left were destroyed by fire.

March 5, 1866. William Whewell died.—A man of encyclopædic knowledge, Whewell was for many years Master of Trinity College, Cambridge. He wrote much on scientific subjects, and made important additions to the theory of tides.

March 6, 1908. William Edward Wilson died.—After accompanying Huggins on an eclipse expedition to Oran, Wilson set up an observatory at Danamona, Westmeath. He carried out notable investigations on the temperature of the sun.

March 7, 1904. Ferdinand André Fouqué died.—A professor of the Collège de France, Fouqué was one of the earliest workers in the field of the microscopic examination of rocks and minerals, of which Sorby was the great pioneer.

March 9, 1851. Hans Christian Oersted died.—Twenty years after Volta's invention of the voltaic pile, Oersted, then professor of natural philosophy at Copenhagen, made the observation that a wire uniting the ends of a voltaic battery affected a magnet in its vicinity. Following up this discovery, in 1820 he published his tract, "Experiments on the Effects of Opposing Electricity upon the Magnetic Needle," the effect of which was described by Forbes as instantaneous and wonderful. The ideas of Oersted were seized upon by Ampère, Arago, Davy, Seebeck, and Faraday, and in their hands led to rapid development of the science of electromagnetism, of which Oersted is rightly regarded as one of the founders.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, February 17.—Prof. C. S. Sherrington, president, in the chair.—Dr. C. **Chree**: A comparison of magnetic declination changes at British observatories. A comparison is made of mean monthly, daily, and hourly values at different stations, and of the relative amplitudes of the oscillatory movements which frequently occur even on comparatively quiet days. Use is made of magnetic curves from Eskdalemuir, Stonyhurst, Falmouth, and Kew observatories.—Prof. H. M. **Macdonald**: The transmission of electric waves around the earth's surface.—Prof. T. H. **Havelock**: The stability of fluid motion. The object is to illustrate the use of the criterion, introduced by Reynolds and modified by Orr, as a measure of the degree of stability of various fluid motions under different boundary conditions. Cases examined are the flow of a stream with a free surface, and the flow between fixed planes under different fields of force and boundary conditions of no slip or no tangential stress or constant normal pressure due to the disturbance from the steady state.—Prof. W. H. **Young**: The transformation of integrals.—Dr. J. L. **Haughton** and Kathleen E. **Bingham**: The constitution of the alloys of aluminium, copper, and zinc containing high percentages of zinc. The constitution of aluminium–copper–zinc alloys containing not more than 15 per cent. of aluminium and 10 per cent. of copper is discussed. The investigation has been carried out by the study of the heat absorptions and evolutions which take place in heating and cooling alloys between temperatures at which they are liquid and ordinary temperatures; by the measurement of electrical resistance at various temperatures; and by microscopic study of specimens which have been annealed for prolonged periods and quenched, or very slowly cooled and quenched. From the results obtained a model has been constructed to represent the constitution at temperatures above 250° C. The diagram advanced by Rosenhain and Archbutt has been used as one face of the ternary prism, the other binary system face being somewhat modified from Tafel's diagram.

Geological Society, February 2.—Mr. R. D. Oldham, president, in the chair.—H. **Bolton**: A new species of Blattoid (Archimylacris) from the Keele group (Stephanian) of Shropshire. The author describes the basal portion of a new type of Blattoid wing found by Mr. John Pringle in core-material of purple marly shale from a borehole for water. The wing belongs to the genus Archimylacris, and is closely allied to *A. Lerichei*, Pruvost, and *A. Dessaillyi*, Leriche, from the upper beds of the Westphalian of Liévin, Northern France.—C. E. **Tilley**: The granite-gneisses of Southern Eyre Peninsula (South Australia) and their associated amphibolites. Southern Eyre Peninsula is underlain by a complex series of pre-Cambrian rocks subject to prolonged erosion, but now in part covered by weathered products and recent æolian sediments. The fundamental platform of the eastern half of the peninsula consists of granite-gneisses, amphibolites, and hornblende-schists, embraced within the Flinders series. The petrography of the rocks is described and the significance of their mineralogical constitution discussed. The gneissic structure is a primary gneissic banding arising from flow-movements in a heterogeneous magma. The amphibolites are considered as representing more basic and earlier igneous intrusions, probably of the same igneous cycle and connected with the one great orogenic epoch, which have become thermally metamorphosed. Inter-

calated in bands in the gneisses of portions of the hundred of Lincoln is a series of dolerites which have suffered a metamorphism of the highest grade.

Zoological Society, February 8.—Prof. E. W. MacBride, vice-president, in the chair.—Dr. C. F. **Sonntag**: The comparative anatomy of the tongues of the Mammalia, family Simiidæ.—D. M. S. **Watson**: Basis of classification of the Theriodontia.

Royal Meteorological Society, February 16.—Mr. R. H. Hooker, president, in the chair.—M. de Carle S. **Salter**: A new method of constructing average monthly rainfall maps. For the present purpose a new series of isomeric maps for the period 1881–1915 has been prepared, on the scale of 20 miles to 1 in., from 550 records. A map showing the distribution of average annual rainfall for thirty-five years has been compiled on the same scale (i) from Dr. H. R. Mill's survey maps on the scale of 2 miles to 1 in. prepared from all available data, and (ii) by computing 1700 additional average values for the districts not yet surveyed. The twelve monthly isomeric maps and the annual map were ruled in a network of squared lines 10 miles apart, and values interpolated at each of the points of intersection The twelve percentage evaluations for each point were collected and severally applied to the value from the annual map, thus obtaining twelve monthly rainfall values applicable to the point in question. The latter were plotted on a fresh series of ruled maps, together with the actual average values for the 550 stations originally utilised, and the whole were used as a basis for isohyetal lines. The whole gave 2573 values for each month, and left no space of more than 10 miles without some means of controlling the drawing of the lines. The paper discusses the limits of error introduced by the method.—G. A. **Clarke**: An unusual pilot-balloon trajectory. A balloon observed by one theodolite was found to pursue a course so erratic that its results, if calculated by the method applicable to the one-theodolite ascents, would have shown a wind of more than 110 miles per hour from W.S.W. at 2500 ft., with a return wind of similar velocity from E.N.E. only 500 ft. higher. Such conditions in the atmosphere being extremely improbable, an endeavour was made to deduce the magnitude of the vertical currents, and it was found that the path described could be accounted for by a descending current of about 6 miles per hour, followed by an ascending one of somewhat similar velocity.

CAMBRIDGE.

Philosophical Society, February 7.—Prof. Seward, president, in the chair.—G. E. **Briggs**: The development of photosynthetic activity during germination.—Prof. G. H. **Hardy**: A theorem concerning summable series.—E. A. **Milne**: Vectors and tensors. The usual intuitive concept of a vector useful in three dimensions no longer serves in four dimensions, and a more precise definition is required, in which, however, the notion of a permanency independent of any particular co-ordinate system is preserved. Consider the class of co-ordinate systems and the class of representations of a particular vector (by means of sets of components) associated with them: it is suggested that a vector be defined as the *class* of such correlated sets.—H. C. **Pocklington**: (*a*) Standing waves parallel to a plane beach. (*b*) A kinetic theory of the universe.—Prof. H. F. **Baker**: (*a*) A configuration in four dimensions. (*b*) The representation of a cubic surface on a quadric surface. (*c*) Delaunay's method in planetary theory. (*d*) A periodic motion in dynamics.

February 21.—Prof. Seward, president, in the chair.—Dr. **Hartridge**: The present position of the Helmholtz theory of hearing.

MANCHESTER.

Literary and Philosophical Society, January 11.—Mr. Francis Jones, vice-president, in the chair.—Dr. A. A. **Mumford**: Testing and grading of health and physical fitness. The author urged the necessity of fresh physical fitness tests for school-children—the present tests mainly dealt with exceptional children, such as the deformed, diseased, and mentally unfit—based on the capacity to put forth effort, and thus considering the work of the heart, lungs, and the nervous system. The tests, brought into prominence by the work of the Air Force, mainly concerned breathing, and were now being adapted to boys in the Manchester Grammar School. The first test, dealing with the amount of air used in respiration, was measured by the spirometer; the second, dealing with the force of respiration, was measured by pressure against a column of mercury; and the third concerned the movements of the chest, which could be examined by means of a specially designed waistcoat.

January 25.—Sir Henry A. Miers, president, in the chair.—W. E. **Alkins**, M. **Cook**, and J. **Harwood**: Variation in Sphæria—(i) *S. lacustre*, Muller; (ii) *S. corneum*, Linné; (iii) *S. pallidum*, Gray. These three papers were mainly confined to the presentation of results and a comparison of species, a general discussion of the significance of the results being reserved for a fourth and concluding paper on *S. rivicola*. Two hundred specimens of *S. lacustre* from Three Lows, North Staffordshire, and five hundred each of *S. corneum* and *S. pallidum* from the Ashton and Guide Bridge Canal, near Dukinfield Station, had to be examined. The authors have studied the variation of width, length, and thickness.

PARIS.

Academy of Sciences, February 7.—M. Georges Lemoine in the chair.—G. **Gouy**: Systems of prisms with parallel edges.—R. **Birkeland**: The resolution of the general algebraic equation by hypergeometric functions of several variables.—E. **Jouguet**: The case of Poincaré in the theory of elasticity. Poincaré has studied the small deformations of an elastic solid, starting with an initial state in which the tensions are not zero. The author examines some thermodynamic properties of elastic solids with similar deformations.—A. **Guillet**: A chronograph recording photographically for the measurement of short periods in harmonic motion or with circular uniform movement by means of Lissajous's figures.—C. **Féry**: A battery depolarised by air. A modification of the Leclanche cell. The zinc is in the form of a horizontal disc placed at the bottom of the cell; the carbon is a cylinder the lower flattened edge of which is immediately above the zinc plate. The removal of the polarising hydrogen by the air causes currents between the upper and lower ends of the carbon cylinder. It is claimed for this battery that no peroxide of manganese is required, local action is absent, and its e.m.f. during use is very constant. It has received practical application in the French Posts and Telegraphs Department, and it has been shown that it lasts three times as long as the old form.—P. **Chevenard**: The expansion anomaly accompanying the magnetic transformation of pyrrhotine and magnetite. In the neighbourhood of 320° C. pyrrhotine suddenly increases in length, corresponding very probably to a true allotropic transformation analogous to the change of α-iron into γ-iron. This hypothesis is confirmed by the fact noted by Weiss, that the magnetisation coefficient of pyrrhotine is nearly independent of the temperature round about 320° C. Magnetite also shows an anomaly in expansion at 570° C.—a temperature near the magnetic Curie point determined by

Weiss.—A. **Liénard**: Electromagnetic energy and thermodynamic potential of a system of currents.—A. **Portevin** and J. **Durand**: Anomaly of expansion of the gold-copper alloys.—L. **Forsén**: The constitution of the derivatives of molybdic acid.—J. **Martinet** and O. **Dornier**: Isatin 5-sulphonic acid. Isatin has not hitherto been directly sulphonated. Details are given for the preparation of isatin 5-sulphonic acid from isatin and fuming sulphuric acid, and some of its salts are described.—H. **Bouygues**: Considerations on the endoderm.—M. and Mme. G. **Villedieu**: The non-toxicity of copper for mildew. The results of experiments on *Phytophthora infestans* (the mildew of potato), controverting the usually accepted view that it is the copper in anticryptogamic mixtures which is efficacious in destroying mildew.—W. **Kopaczewski**: The *rôle* of surface tension in the phenomena of shock. The surface tension of serum is reduced by the addition of a solution of sodium hyposulphite. The author attributes the suppression of the anaphylactic shock by sodium hyposulphite solutions to this change in surface tension, and not to the effect of this salt in dispersing flocculated serum.—A. **Trillat**: The influence of the state of division of droplets containing bacteria on the infection of culture media.—MM. **Desgrez**, **Guillemard**, and **Labat**: The use of the alkaline polysulphides for the neutralisation of certain toxic gases. Spraying with a sodium polysulphide soap solution, originally suggested for the removal of chloropicrin vapour from air, has been found to be also efficacious in removing other toxic gases. Figures are given for the amounts required to remove chlorine, phosgene, acrolein, bromoacetone, and other noxious vapours.

Books Received.

The Government of the Philippine Islands. Philippine Census, A.D. 1918. Manila: The Climate and Weather of the Philippines, 1903 to 1918. By the Rev. J. Coronas. Pp. 195. (Manila: Bureau of Printing.)

What to Read on Social and Economic Subjects. A Select Bibliography Compiled by the Fabian Society. Sixth edition. Pp. xii+80. (London: The Fabian Society; G. Allen and Unwin, Ltd.) 2*s*. net.

The Boy in Industry and Leisure. By the Rev. R. R. Hyde. (Social Service Library.) Pp. xxviii+281. (London: G. Bell and Sons, Ltd.) 6*s*. net.

Small Single Phase Transformers. By E. T. Painton. Pp. x+95. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Elementary Principles of Continuous-Current Armature Winding. By F. M. Denton. Pp. x+102. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

A Guide to the Preparation of a Note-Book of Biology. By E. W. Shann. Pp. 48. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*. net.

Mitteilungen der Naturforschenden Gesellschaft in Bern aus dem Jahre 1919. Pp. lxxv+231+v Tafel. (Bern: K. J. Wyss Erben.)

The Breeding and Feeding of Farm Stock. By J. Wilson. Pp. vii+152. (London: Methuen and Co., Ltd.) 6*s*. net.

A Book of Butter: A Text on the Nature, Manufacture, and Marketing of the Product. By Prof. E. S. Guthrie. Pp. xv+270. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s*. net.

Report of the Indian Association for the Cultivation of Science and Proceedings of the Science Convention for the Year 1918. Pp. iii+199+xxxi+plates. (Calcutta.)

Economic Mineralogy: A Practical Guide to the Study of Useful Minerals. By T. Crook. Pp. xi+492. (London: Longmans, Green and Co.) 25*s*. net.

Insect Life. By C. A. Ealand. Pp. xii+340+lxxiv plates. (London: A. and C. Black, Ltd.) 30*s*. net.

In Farthest Burma: The Record of an Arduous Journey of Exploration and Research through the Unknown Frontier Territory of Burma and Tibet. By Capt. F. K. Ward. Pp. 311. (London: Seeley, Service and Co., Ltd.) 25*s*. net.

The Subject Index to Periodicals, 1917–19. B–E: Historical, Political, and Economic Sciences. Pp. 248. (London: The Library Association.) 21*s*. net.

Transactions of the Norfolk and Norwich Naturalists' Society. Presented to Members for 1919–20. Vol. xi., part 1, December. Pp. xiii+101. (Norwich.) 7*s*. 6*d*.

Annuaire Astronomique et Météorologique pour 1921. 57 Année. By C. Flammarion. Pp. 251. (Paris: E. Flammarion.) 8 francs.

Department of Applied Statistics (Computing Section), University of London, University College. Tracts for Computers. Edited by Karl Pearson. No. iv.: Tables of the Logarithms of the Complete Γ-function to Twelve Figures. Originally computed by A. M. Legendre. Pp. 4+10. (London: Cambridge University Press.) 3*s*. 9*d*. net.

The National Physical Laboratory. Collected Researches. Vol. xv., 1920. Pp. iv+329+plates. (London: H.M. Stationery Office.) 20*s*. net.

Diary of Societies.

THURSDAY, MARCH 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Balfour Browne: Mason Wasps.

ROYAL SOCIETY, at 4.30.—Discussion on Isotopes to be opened by Sir J. J. Thomson, followed probably by Dr. F. W. Aston, Prof. F. Soddy, Prof. T. R. Merton, and Prof. F. A. Lindemann.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.—J. W. W. Dyer: Airship Fabrics.—Major T. Orde Lees: Parachutes.

LINNEAN SOCIETY, at 5.—R. T. Günther: A Manuscript of Matthias de Lobel, from the Library of Magdalen College, Oxford.—Dr. B. Daydon Jackson: Naturalists and their Indebtedness to the National Trust.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Graham: Glycæmia and Glycosuria (Goulstonian Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss M. C. Buysman: The Value of the Drama in the Training of the Child's Emotions.

CHEMICAL SOCIETY, at 8.—C. K. Ingold and J. F. Thorpe: The Chemistry of the Glutaconic Acids. Part XII. The Simultaneous Occurrence of 1:2- and of 1:3-Addition to Glutaconic Ester. A Study in Mobile Equilibrium involving the Utilisation of the Labile Ester in the "Nascent" Condition.—E. C. C. Baly and W. F. Barker: The Photochemical Reaction between Hydrogen and Chlorine, and its Variation with the Intensity of the Light.—J. Kenner and W. V. Stubbings: A Second Form of 6:6′-Dinitrodiphenic Acid and its Conversion into New Cyclic Systems.—J. Moir: The Calculation of the Colour of Monocyclic Coloured Substances.—N. V. Sidgwick and E. K. Ewbank: The Stability of Tautomeric Formaldehydrazones.—F. W. Atack and L. Whinyates: The Structural Isomerism of Oximes. Part III. A Fourth Benzildioxime.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. G. Evans: A Study of the Condition of the Arteries in a Uterus Removed 24 Days after Delivery.—Dr. A. Bourne: Puerperal Salpingo-peritonitis.

FRIDAY, MARCH 4.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Problems of Seismology: opened by Prof. H. Lamb, followed by Dr. G. W. Walker, R. D. Oldham, and J. J. Shaw. Chairman: Prof. H. H. Turner.

INSTITUTION OF MECHANICAL ENGINEERS AND THE SOCIETY OF CHEMICAL INDUSTRY (Joint Meeting), at 6.—P. Kestner: Degassing and Purification of Boiler Feed-Water.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at Faraday House), at 6.30.—A. Rosen: Telephonic Transmission through Submarine Cables.

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—W. H. Simmons: Manufacture of Gun-cotton.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—R. Apperly: The Importance of the Examination of the Patient by the Anæsthetist, Previous to Anæsthesia.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—W. A. Tait: Severn Crossings and Tidal Power.

SATURDAY, MARCH 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Electricity and Matter.

MONDAY, MARCH 7.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. H. Costley White: Public School Education.
ROYAL INSTITUTION OF GREAT BRITAIN (General Meeting), at 5.
SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—R. W. A. Brewer: Some Modern Engineering Practice in America.
ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—Prof. J. E. Boodin: Cosmic Evolution.
ROYAL SOCIETY OF ARTS, at 8.—Major G. W. C. Kaye: X-rays and their Industrial Applications (Cantor Lecture).
SOCIETY OF CHEMICAL INDUSTRY (at Chemical Society), at 8.—Dr. J. C. Drummond: Factors Influencing the Food Value of Lard and Lard Substitutes.—Dr. R. C. Farmer: The Stability of Benzoyl Peroxide.
SURVEYORS' INSTITUTION, at 8.—A. B. D. Lang: The Report from the Select Committee of the House of Commons on Business Premises.
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—J. H. Driberg: The Lango District, Uganda Protectorate.
MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 9.—G. E. Gask: Surgery of the Lung and Pleura (Lettsomian Lecture).

TUESDAY, MARCH 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof A. Keith: Darwin's Theory of Man's Origin in the Light of Present-Day Evidence.
ROYAL HORTICULTURAL SOCIETY, at 3.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Graham: Glycæmia and Glycosuria (Goulstonian Lecture).
INSTITUTION OF CIVIL ENGINEERS, at 5.30.—S. Leggett: The Amritsar Hydro-electric Irrigation Installation.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—E. G. Boulenger: Experiments on Colour-changes of the Spotted Salamander (*Salamandra maculosa*), conducted in the Society's Gardens.—Miss Joan B. Procter: The Variation of the Scapula in the Batrachian Groups Aglossa and Arcifera.—Dr. W. T. Calman: Notes on Marine Wood-boring Animals. II. Crustacea.—Augusta Arnbäck Christie-Linde: The Reproductive Organs of the Ascidian *Kükenthalia borealis*, Gottschaldt.—B. P. Uvarov: The Geographical Distribution of Orthopterous Insects in the Caucasus and in Western Asia.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.
QUEKETT MICROSCOPICAL CLUB, at 7.30.
ROYAL ANTHROPOLOGICAL INSTITUTE (Special Meeting), at 8.15.—Prof. F. G. Parsons: The Head Form of the Long Barrow Race, with Reference to the Modern Inhabitants of London.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. H. Devine: Study of Hallucinations in a Case of Schizophrenia.

WEDNESDAY, MARCH 9.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10.30 and 2.30.—Prof. H. C. H. Carpenter and Constance F. Elam: Stages in the Re-Crystallisation of Aluminium Sheet on Heating, with a Note on the Birth of Crystals in Strained Metals and Alloys.—P. H. Brace: Some Notes on Calcium.—Prof. C. A. Edwards and A. M. Herbert: Plastic Deformation of Some Copper Alloys at Elevated Temperatures.—H. Moore and S. Beckinsale: The Action of Reducing Gases on Heated Copper.
ROYAL SOCIETY OF ARTS, at 4.30.—W. Dewar: The Plumage Trade and the Destruction of Birds.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. B. R. King: The Surface of the Marls of the Middle Chalk in the Somme Valley and the Neighbouring Parts of Northern France, and the Effect on the Hydrology.—Gertrude L. Elles: The Bala Country: Its Structure and Rock-Succession.

THURSDAY, MARCH 10.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10.30.—H. Moore, S. Beckinsale, and Clarice E. Mallinson: The Season Cracking of Brass and Other Copper Alloys.—Dr. J. L. Haughton: The Constitution of the Alloys of Copper with Tin, Parts III. and IV.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: The Meteorology of the Antarctic.
ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Sir Joseph Larmor: Electro-crystalline Properties as Conditioned by Atomic Lattices.—Lord Rayleigh: The Colour of the Light from the Night Sky.—Prof. A. S. Eddington: A Generalisation of Weyl's Theory of the Electromagnetic and Gravitational Fields.—Prof. T. R. Merton: Spectrophotometry in the Visible and Ultra-violet Spectrum.—Prof. W. A. Bone: Researches upon Brown Coals and Lignites.—H. N. Russell: A Superior Limit to the Age of the Earth's Crust.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.
ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Whitfield: Some Points in the Etiology of Skin Diseases.
ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Discussion: The Place of Baths and Health Resorts in Gynæcology.
INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Prof. E. Wilson: Feebly Magnetic Materials: Practical Applications.
OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Prof. H. F. Newall: The Story of a New Star (Lecture).—T. F. Connolly: Note on a Handy Form of Measuring Microscope.
ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections, Joint Meeting), at 8.—Dr. G. Holmes, L. Paton, and Others: Ocular Palsies.

FRIDAY, MARCH 11.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, the Imperial College of Science), at 2.30.—Exhibits and Short Communications.—Dr. J. Davidson: The Cells of Plant Tissues in Relation to Cell-sap as the Food of Aphids.—E. R. Speyer: Ceylon Scolytid Beetles: their Bionomics and Relation to Ambrosia Fungi and Problems of Plant Physiology
ROYAL ASTRONOMICAL SOCIETY, at 5.
PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Prof. A. A. Michelson: Some Recent Applications of Interference Methods (Sixth Guthrie Lecture).
ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at King's College), at 6.30.—J. A. Broughall: Some Recent Developments in Converting Machinery for Small Substations.
ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections, Joint Meeting), at 8.30.—Dr. G. Holmes, L. Paton, and Others: Ocular Palsies.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. J. Freeman: Medical Idiosyncrasies.

SATURDAY, MARCH 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Electricity and Matter.
PHYSIOLOGICAL SOCIETY (at Institute of Physiology, University College), at 4.

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