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British Dyes and Dyestuffs.

THE Sub-committee appointed on December 2, 1919, by the Standing Committee on Trusts to "ascertain to what extent supplies, prices, and costs of dyes and dyestuffs in this country, and profits thereon, are affected by any trade combination" has now reported under date May 18, 1921. The Report (Cmd. 1370, 4*d.* net) comprises fifty-five clauses, from which are drawn twenty conclusions, these being widely traversed in a minority report presented by Major Harry Barnes, M.P.

The first fourteen clauses reveal nothing which is not already familiar to those who have given more than superficial attention to the subject. A synopsis of the factors which had placed this country in a position of such complete inferiority to Germany as that which existed prior to the war brings out from their stable the two familiar stalking-horses, patent law and industrial alcohol.

"Further to these it has been said that in the early days there was a certain slackness and a lack of organisation on the part of the British manufacturers, who were content, for instance, to send out circulars whilst the Germans sent out travellers who were not only salesmen but skilled chemists; and it is asserted that the whole course of the development of synthetic dyes in this country subsequent to the initial discovery exhibits a lack of properly directed scientific research. But whether these were contributory causes of the passing of the dyes industry out of this country, or whether they were accompaniments or results of the heavy handicap of unfair patent arrangements and unintelligent prevision as regards the use of industrial alcohol, is a matter on which there are differences of opinion" (clause 3).

This lengthy passage has been quoted because it offers an example of the confused thinking which it appears to be the fate of the dye-making industry to receive. Moreover, it is characteristic of the whole Report, which studiously avoids arriving at a conclusion that is not open to contradiction elsewhere in its pages; Major Barnes is more direct. Thus the Sub-committee is unable or unwilling to determine the relative value of the contributions to the industry made by duty-free alcohol on one hand, and by "properly directed scientific research" on the other. Perhaps it was not represented to the Committee that if the textile manufacturers of the sixties of last century had possessed imagination enough to set aside only 1 per cent. of their profits to develop what might then have been regarded as a branch of their own industry, Hofmann, Brunck, Caro, Martius, and Böttinger need never have left this country to build up the chemical industry of Germany, and a brisk demand for young chemists might have led Oxford and Cambridge then to weigh their responsibility towards that branch of knowledge which underlies all modern industry and all forms of life.

This nice reluctance to face an issue characterises also the treatment accorded by the thirteen agreed members to the main question upon which their deliberation was invited—namely, the extent to which the supply and cost of dyes have been affected by "any trade combination," otherwise the British Dyestuffs Corporation. Rightly declaring that "If the Corporation is over-capitalised its ability to sell at a reasonable price, while making a reasonable profit, will be in so far diminished" (clause 17), the Committee proceeds to analyse the financial basis of the amalgamation between British Dyes, Ltd., and Messrs. Levinstein which followed from the rejection in August, 1918, by the shareholders in the former company, of the alternative scheme proposed by the board of directors. The analysis recalls the fact that, the nominal capital of Messrs. Levinstein having been divided into 3000 preference shares (10*l.*) and 6000 ordinary shares (10*l.*), the preference shareholders received in exchange preference shares in the Corporation of an equal nominal amount, or cash at their option.

The holders of ordinary shares were more fortunate. The valuation of the net assets available for distribution to them showed a total of 348,000*l*., and for this they received 174,000*l*. of 7 per cent. preference, 174,000*l*. of 8 per cent. preferred ordinary, and 450,000*l*. of 8 per cent. deferred ordinary shares, the last-named representing "goodwill, patent and other rights." Evidently the Sub-committee felt that such generosity requires an explanation, particularly as "It has been alleged that for fifteen years before the war Messrs. Levinstein's had not paid a dividend"; but the members were satisfied with the reflection that "the policy of the company had in general been not to pay out profits in dividends, but to put the profits back into the business" (clause 21). Fifteen years' abnegation of all dividends would certainly appear to merit recompense, but the fact that the present market valuation of the 798,000*l*. scarcely exceeds 100,000*l*. is a curious comment on the propriety of the original allocation. "The net value of the assets of British Dyes, Ltd., showed a total of 1,143,580*l*. available for distribution to the ordinary shareholders, and this was satisfied as to one-half by the issue of preference shares and as to the other half by the issue of preferred ordinary shares in the Corporation. In addition, the shareholders in British Dyes, Ltd., were entitled to an issue of 550,000 deferred ordinary shares in respect of goodwill, patent and other rights" (clause 20). Thus 1,000,000*l*. of deferred ordinary shares were created, adding 80,000*l*. per annum to the interest charges.

The Report is not so clear as to the allocation made to the Government. The statement that "The Government subscribed for 850,000 preference and 850,000 preferred ordinary shares in substitution for the loan on debentures to British Dyes, Ltd., of 1,700,000*l*. to which they were committed" (clause 10), does not reveal the proportion of the 1,700,000*l*. which had been loaned to British Dyes, Ltd.; the sum mentioned is that "to which they were committed," and it has not been publicly stated that the amount actually loaned was in excess of 1,200,000*l*. Remembering that the Government debenture was at 4 per cent., and that the average nominal rate of the preference and preferred ordinary shares is 7½ per cent., it will be recognised that this allocation represented an additional interest charge of at least 60,000*l*. per annum on the earning capacity of the Corporation.

Conclusion (7), nevertheless, states that the thirteen agreed members "do not consider that the Corporation is under the handicap of over-capitalisation, except in so far as the buildings, plant, etc., of the British Dyestuffs Corporation, Ltd., were erected at a time of high prices and feverish conditions," whilst Major Barnes's conviction is that "the Corporation is over-capitalised, and the Government, before investing public monies in same, should have insisted on the buildings and plant provided out of the abnormal war profits being written down to pre-war costs." Those who have difficulty in deciding between these conflicting opinions may be assisted by the recollection that the German companies, with which the Corporation must ultimately find itself in competition, have consistently practised the policy of under-capitalisation by returning a large proportion of their profits to the business in the form of expenditure on development and research. The Sub-committee is silent on this point. One of the inducements to potential subscribers offered by the prospectus of the British Dyestuffs Corporation in 1919 was a synopsis of the profits earned by the German "Big Four" during 1913, showing 2,499,592*l*. to have been the fruit of share capital and reserves aggregating 9,886,318*l*.; owing to the prudent policy indicated above, however, the nominal ten millions were notoriously nearer twenty millions in actual value, thus reducing the profit to the neighbourhood of 12 per cent., which is not an excessive figure for an industry which was virtually a world-monopoly.

In addition to the capital inflation indicated above, one most regrettable feature of the amalgamation was the destruction of the co-operative character of British Dyes, Ltd. Shareholders in that company were confined to dye-users, and the rate of interest was limited to 6 per cent. so long as the Government debenture remained unredeemed. Consequently, there was no inducement to charge prices higher than would pay this modest interest and provide funds for the prosecution of research and the development of new processes. "The influence of the amalgamation on prices is submerged by the other influences at work, and our attempts to single it out for separate examination have proved fruitless" (clause 39). Nevertheless, the schedule of prices for dyes is a startling contribution to the Report, showing percentage increases in March, 1921, over July, 1914, which are seldom less than 500, and often exceed 1000; but there is no evidence to show that they are in any way due to the combination. That is really the conclusion of the whole matter, and whilst the sessions of the Sub-committee were doubtless full of interest and information to the members, it unfortunately happens that the Report will not contribute anything substantial towards a solution of the desperate problem with which the country remains confronted.

A War Memorial.

The Scientific Papers of Bertram Hopkinson. Collected and arranged by Sir J. Alfred Ewing and Sir Joseph Larmor. Pp. xxvii + 480 + plates. (Cambridge: At the University Press, 1921.) 63*s*. net.

BERTRAM HOPKINSON'S scientific friends, including his Cambridge staff, decided well when they determined that no memorial could be more suitable or permanent than a collected edition of his writings on mathematical and engineering science. The editors and the syndics of the Cambridge University Press alike have earned our thanks by the manner in which their shares of the publication have been carried out.

There is no need to tell at length the tragic story of his life. Called home from Aden in 1898 by the death of his father, brother, and two sisters on the Dents de Veisivi, he took up his father's work as a consulting engineer with the aid of his uncle Charles, and carried out various important undertakings. Five years later he became professor of mechanism at Cambridge, and in the same year he married. For the next eleven years he was fully occupied in the development of the work of his chair. The papers in the volume under review form his contributions to science during that time, but they do not constitute by any means the whole of the debt we owe to him. To quote from Prof. A. V. Hill's appreciation in the *Alpine Journal,* at Cambridge

"a professor of mechanism can hope to make a school essentially in touch with the traditions of the place only on condition that his interests are largely, if not mainly, scientific. In Hopkinson Cambridge had an ideal professor, and the pupils trained in his school have already, especially during the war, raised a memorial to him by their work."

The war, when it came, claimed him at once, at first as a teacher at Chatham, then at the Admiralty, where he conducted some most important experiments which led to the modern methods of protection of large ships against torpedoes. Finally he joined the Royal Air Force as an officer in charge of experimental work of all kinds, becoming in June, 1918, Deputy Controller of the Technical Department; on August 26 of that year he was killed in a flying accident.

The papers in the volume fall naturally into three main groups, dealing respectively with electrical engineering, with certain metallurgical questions, and with the problems of the internal-combustion engine. In addition, the first paper of the series, one on sources and vortices, which was contributed to the London Mathematical Society in 1898, deserves mention as indicating the width of his knowledge and interests. He was an electrical engineer by profession; his father had placed the construction of electrical machinery on a scientific basis by the paper on dynamo-electric machines written in conjunction with his uncle Edward, and published in the Phil. Trans., and it was not unnatural that the son's early work as professor should deal with similar problems.

His first paper in the Proceedings of the Royal Society on the shunting of alternate-current machines gave a satisfactory explanation of the phenomenon, and seems to have been inspired in part by the behaviour of a small machine in the Wimbledon Power House near his home.

Electrotechnics did not for long retain his main attention. Papers on the elastic properties of steel at high temperatures, brittleness and ductility, and the endurance of metals under alternating stresses of high frequency, followed during the next few years, and each served to bring out his versatility and his power of getting at the heart of a subject and of explaining in clear and concise language the results of his investigations.

Two remarkable papers on the magnetic properties of iron and its alloys in strong magnetic fields, and on manganese steels, were published with Sir Robert Hadfield in 1911 and 1914, and have added greatly to our knowledge of magnetism. Hopkinson was able to show that the magnetism of saturation might, in the case of the carbon steels, be predicted from the composition by treating each steel as a mixture of iron and of less magnetisable carbide. With manganese, however, no such simple relation was found to follow.

The work, however, by which Hopkinson will probably be best remembered is that on the internal-combustion engine. It began with a British Association paper in 1904, which led in 1907 to an investigation into the efficiency of the gas engine; in the course of this research the well-known Hopkinson indicator was developed, and it was shown that indicator diagrams, properly drawn, could be used satisfactorily for the measurement of efficiency. In 1906 a most important paper on the distribution of temperature in an explosion cylinder was communicated to the Royal Society, and the discussion aroused on these matters led to the formation of the Gaseous Explosions Committee of the British Association, of which Sir Dugald Clerk was chairman, and Hopkinson secretary. Much, probably most, of our recent knowledge of the theory of the internal-combustion engine has sprung from the labours of that committee, and to the advance made Hopkinson was a most important contributor. It is sufficient, perhaps, to mention his last paper on the subject, "On Radiation in a Gaseous Explosion," communicated to the Royal Society in 1910; the work thus begun has recently been brought to a most satisfactory conclusion by his pupil and assistant, Mr. W. T. David. In conclusion, reference should be made to a lecture at the Royal Institution, 1912, on "The Pressure of a Blow," and to the Royal Society paper on "A Method of Measuring the Pressure due to the Detonation of High Explosives," which led in a simple way to results of marked interest.

Enough has probably been written to show the high value of the work Hopkinson did, and the magnitude of the loss to engineering science caused by his early death. To quote the words of Sir J. J. Thomson, speaking as Master of Trinity in a commemorative address, "our roll of honour contains the name of no one who has rendered greater services to his country."

The New Medicine.

The Principles of Preventive Medicine. By Prof. R. T. Hewlett and Dr. A. T. Nankivell. Pp. viii+536. (London: J. and A. Churchill, 1921.) 21*s.* net.

THE object of Prof. Hewlett and Dr. Nankivell in writing this book was to give an outline of the principles and practice of preventive medicine "so far as it seems to concern the medical student and the general practitioner of medicine." That there was need for such a book there is no doubt. All who are concerned in any way with the teaching or practice of public health and preventive medicine certainly must agree that such a book was required, just as they must agree that this volume by Prof. Hewlett and Dr. Nankivell goes some distance towards supplying the need. The preparation of the book, the authors admit, gave considerable trouble, the extent of the field to be covered rendering it difficult to decide what to include and what to omit. In all book-making this is always a difficult thing, but in this case the authors have chosen wisely, and in the twenty-one chapters and three appendices they appear to have made reference to all the more important matters in respect of which the medical student and the practitioner—who, after all, are expected to play a great part in the preventive medicine of the future—need information.

As might be expected in a book prepared by two practical men like Prof. Hewlett and Dr. Nankivell, one a distinguished bacteriologist, and the other a Medical Officer of Health of some years' standing, the information given is trustworthy. Here and there in the writing, however, there is shown a tendency to leave the lines followed in the ordinary medical books, and to indulge in what may almost be called "flights of fancy." In a number of places the authors appear unable to avoid the temptation to drop into poetry, and to provide word-pictures in which they use much more colour than appears to be essential in a book intended for such dispassionate readers as medical students and practitioners are, or should be. The chapters in which the fancifulness and the overdrawing are most frequently to be met are, curiously enough, those in which serious writing and strict accuracy of expression are most called for—viz. those dealing with housing, infancy, motherhood, and school children—and though there may be some who will appreciate the picturesque and exaggerated phrasing at its true value and find it helpful, it seems not unlikely that more will regard it as objectionable and out of place. In any case, it seems unfortunate that in one of the first books on preventive medicine the line here chosen should have been taken, and the impression given that the subject is one which is most suitably dealt with in a style more popular than scientific.

In the chapters dealing with infectious diseases the authors have exercised greater restraint and provided an amount of interesting, useful, and sound information. These chapters are amongst the most valuable in the book, and are particularly noteworthy for a declaration against the tendency to search out and find specific germs of disease, and more or less in favour of the view that, since they can be shown to change their shape and even their virulence on occasion, there is no such thing as constancy among micro-organisms. It is not, therefore, too much to suppose them capable of undergoing such transformations as will allow them to produce one type of disease at one time and another of an associated type at some other time. Another excellent chapter—although by the medical student and practitioner it may be regarded as rather more full of arithmetic and mathematics than is absolutely essential—is that on vital statistics. Amongst readers who will appreciate it are medical men in practice as Medical Officers of Health, many of whom find guidance in this connection necessary occasionally.

"Hewlett and Nankivell," as the book will inevitably be called, is certain of a great welcome, and equally certain to be classed as good. The feeling cannot, however, be escaped that it would have been better if the authors had avoided the faults in style to which reference has been made. In the second edition, which, no doubt, will soon be required, an opportunity for dropping some of the more lurid of the descriptive matter will occur, and it is to be hoped that the space thus released may be utilised for the presentation of some illustrations in addition to, or even in place of, a number of the charts and diagrams which alone adorn the present edition.

Non-Ferrous Metallurgy.

Handbook of Metallurgy. By Prof. C. Schnabel. Translated by Prof. H. Louis. Third edition, revised by the translator. Vol. i., *Copper—Lead—Silver—Gold.* Pp. xxi+1171. (London: Macmillan and Co., Ltd., 1921.) 40*s*. net.

THIS well-known work on the metallurgy of the non-ferrous metals was first made available to the English metallurgist in 1898 by Prof. H. Louis. At that time there was not, in the English language, a complete treatise on this branch of the subject, and it was at once recognised that the book was an addition to our literature. The fact that Prof. Louis had rendered metallurgists a valuable service receives confirmation in the demand for a third edition. In preparing this new edition, Prof. Louis wisely decided to bring the work up to date himself, and not to wait for the publication of the third German edition, for, as he states in the preface, "all the important modern improvements in metallurgical practices are to be found in English-speaking countries."

A work of this kind, which covers such a wide field, takes considerable time to revise, and the war, having intervened during its preparation, has prevented some of the more recent developments from being recorded; but, in spite of this, the book will be found to be most useful and to have distinct value.

The volume which is now published deals with the metallurgy of copper, lead, silver, and gold. The original form of the work is still maintained, but the previous edition has been increased by about forty-five pages. The actual addition of new matter is greater than is represented by this increase, for obsolete processes have been deleted. Considering the progress made in recent years, it is evident that Prof. Louis has had a difficult task in including the descriptions of modern methods without seriously increasing the size of the volume. For this reason the cutting down of the older processes might perhaps have been somewhat more drastic. Some of the processes described under silver, and also the "chlorination process" for the extraction of gold, have not a wide application at the present time, and are scarcely worthy of the space they have been allowed.

Besides the general revision, the section on calcination furnaces in the part on copper has been extended, the chief furnaces being described; also a concise description of the blast-roasting of copper ores is given, and the section on the Bessemer process of copper extraction has been enlarged. Among the additions made under lead are: The Savelsberg process, blast-roasting without lime, pot-roasting, and down-draught sintering processes. The part devoted to gold has received much attention, and has been improved by a clear and, in the space available, complete account of the cyanidation process—fine-grinding, various methods of classification, and the "all-slime process" being included.

There are two points open to criticism. In regard to the original matter, no indication is given that any of it has become of less practical value; consequently, students may receive the impression that some of the older processes are as important as, or even more important than, some of the chief modern methods. Moreover, the retention of a statement such as "the more recent form of" made in connection with the description of a plant which was given in the first edition twenty-three years ago is liable to be misleading.

The volume, as a whole, is comprehensive and accurate, and can be recommended with confidence. Prof. Louis is to be congratulated on having prepared this new edition and brought the book up to date. It is a pity that most readers will not be able to determine which is really the translator's work and so to judge of its excellence.

E. C.

The Confidences of Men of Science.

The Purple Sapphire, and other Posthumous Papers. Selected from the Unofficial Records of the University of Cosmopoli by Christopher Blayre. Pp. x+210. (London: Philip Allan and Co., 1921.) 7*s*. 6*d*. net.

THE author—or, to be more accurate, the editor—of this fascinating but blazingly indiscreet volume refers to NATURE as "that admirable journal"—a compliment which ought perhaps to secure a benevolent review, but needless to say we shall not let it induce us to depart from our habitual detachment.

Mr. Blayre was for many years Registrar in a well-known university, and had certain manuscripts confided to him by more or less scientific members of the staff on the understanding that they should remain *in retentis*, as who should say, unless events occurred which rendered their publication desirable. In no case, however, were they to be published in the lifetime of the depositors, to whom the documentation served as a sort of Freudian relief. Now there is no doubt that the publication clears up many puzzling events, such as the ghastly damage that followed the acceptance of the so-called "purple sapphire" by the Mineralogical Museum, the mystery of Prof. Markwand's death, and the tragic case of Austin Black, who, if anyone, must be credited with laying the foundations of psychobiology.

To clear up these and other obscurities, more familiar to the older than to the younger readers of NATURE, has seemed to Mr. Blayre sufficient warrant for publishing the deposited documents. He does not seem to be aware, however, that the Professor of Biology, the present reviewer, is still alive, and by no means so sure as he once was of Mr. Blayre's fiducial discretion. His feeling of relief when he found that his own document had been suppressed by the publishers enables him to sympathise at least with the relatives of the deceased gentlemen whose confidences are now blazoned abroad. It is true that names are sometimes suppressed or modified in the book, but in these days, when the study of the history of science is rife, it seems a cruelly thin disguise to refer to a professor by a pseudonym and then proceed to mention one of his well-known discoveries.

Apart from our own survival, which rather condemns the book, apart, also, from the editor's hurry to disclose the confidences of well-known men of science, we would protest against the somewhat amateurish editing. "Science" was never Mr. Blayre's *métier*, and we see that in his editing. When, for example, was Prof. Tyndall knighted, and how could there possibly be a monkey, even a small monkey, inside a bunch of bananas? Even the date of the preface is wrong; and Lingulella figuring as a Lamellibranch (!) is a very dead fly in the ointment. Would it not have been wiser to have submitted the papers for editorial purposes to the present heads of the various departments concerned, and to have issued them as a volume of "University Studies"?

At the same time, many will be grateful to Mr. Blayre for publishing these papers with their poignant personalities and astonishing intimacies. They have made many obscure things clear, and they show us how human men of science are after all. But it is strange to read nowadays of the timidity with which the Professors of Botany and Zoology regarded the development of the cosmic dust, which is now a common item in the kinematographic repertory.

THE PROFESSOR OF BIOLOGY.

Our Bookshelf.

The Breeding and Feeding of Farm Stock. By J. Wilson. Pp. vii+152. (London: Methuen and Co., Ltd., 1921.) 6s. net.

THIS work attempts to treat of a vast subject within a hundred and fifty pages of medium size and type, and there is no preface or preliminary word denoting that the talented author asks for that indulgence which may be claimed by a purely elementary treatise. So ambitious an endeavour courts criticism, and, in this case, no student of the subject could say that it is undeserved. Even in such a hurried summary a few words might have been spared to warn the tyro when the text was meant to be dogmatic and when the author was merely drawing upon a well-trained imagination. Perhaps the best example of such a caution being needed is to be found on p. 26. Here a truly skilful flight of fancy reads as if there were some scientific evidence to support the writer's faith in his own imagery. The harmful effect of the lack of necessary explanations may be found in sentences which can be described, read as they stand, only as the travesty of truth: *e.g.* we read on p. 65: "Sometimes a breed is recommended because it can live on little food, but, if a breed or an individual cow lives upon little food, then neither the breed nor the cow is a good milker."

Besides such inexactitudes, there are many omissions of reference to work throwing light on problems discussed. Nevertheless the book contains much that is interesting and instructive, and some matter that is inspiring. While it cannot be wished that the present work may be republished in its present epitomised form, it is to be hoped that the author will become more ambitious and give his readers, in a larger volume, or in several, the elaborated results of his study of this very important subject.

K. J. J. M.

John Dalton. By L. J. Neville-Polley. (Pioneers of Progress. Men of Science.) Pp. 63. (London: S.P.C.K.; New York: The Macmillan Co., 1920.) 2s.

WITHIN the last ten years chemistry has completely emancipated itself from a type of metaphysical obscurantism which seems to be invading physics in another disguise. Although a scientific atomic theory, as distinguished from the merely poetic efforts of the Greeks, appeared early in the seventeenth century, the chemical atomic theory on which the science is based is unquestionably the work of John Dalton. The story of Dalton has been told before, but the present small memoir may be welcomed as an interesting account which should find favour with students and the general reader.

Very few slips have been noticed. Garnett was Davy's predecessor at the Royal Institution; "Cruickshanks" (p. 28) should be "Cruickshank"; Thenard wrote his own name both as "Thenard" and as "Thénard"—the first was used by his contemporaries, but the second form, used by Mr. Neville-Polley, seems to be common now. It is scarcely correct to describe Thomas Thomson as the "great friend" of Dalton, for at the time of his visit to Manchester to get the account of the origin of the atomic theory accepted prior to Roscoe and Harden's investigations, Thomson was not personally acquainted with its author. The statement that Higgins "assigned the same weight to all atoms" was refuted by Meldrum, whose work should have been mentioned.

Geological Survey of Nigeria. Bulletin No. 1. The Geology of the Plateau Tin Fields. By Dr. J. D. Falconer. Pp. 55+x plates. (Nigeria: Geological Survey of Nigeria, 1921.) 10*s.* net.

IN the first Bulletin of the Nigerian Geological Survey Dr. Falconer has given a useful account of the tin-bearing region of the Protectorate. Ancient schists and gneissose granites have been invaded by newer granites, followed by emanations rich in tin and fluorine but not in boron. Long afterwards, when the country had been worn down by atmospheric agencies, it was covered by the "Fluvio-marine Series"—volcanic rocks, and river gravels often rich in tin. Still later these were succeeded by younger volcanic rocks which have in some cases capped and preserved the older sediments. The alluvial beds that are still in process of formation are, however, the chief source of tin. Their investigation not only furnishes information on the occurrence of alluvial tin, but throws light on the problems of river erosion and deposition. The publication under notice, which is illustrated by excellent photographs of scenery and micro-sections as well as by maps, will be welcomed both by geologists and by mining engineers, though some analyses of the chief rock-types would have been a useful addition.

It is worth consideration whether it would not be possible to supplement a scientific publication like this by a non-technical pamphlet, clearly but simply written without assuming any previous knowledge of the subject. It should be provided with a general geological map, typical views, and large-scale maps and sections, and the meaning of these should be carefully explained. Such publications would go far to promote a more general interest in the study of the rocks and the minerals they contain.

J. W. EVANS.

The Land of Goshen and the Exodus. By Sir Hanbury Brown. Third edition. Pp. 189. (London: Edward Stanford, Ltd., 1919.) 7*s.* 6*d.* net.

THIS extraordinarily interesting account of the bondage of Israel in Egypt and their exodus therefrom, written with the erudition of the scholar and the charm of the non-professional, is issued a third time. Sir Hanbury Brown advocates the view that the land of Goshen lay immediately west of the present Suez Ship Canal, that the western arm of the Red Sea extended at the time of the exodus over the Bitter Lakes and Lake Timsah, almost as far as Tel el Maskhûta (Pithom of the Bible), and that the crossing of the Red Sea took place between Lake Timsah and the Bitter Lakes, below Tussum, near Serapeum. In the new edition he contends that the term "Yam Sûph" refers to the expanse of water now called the Red Sea, in opposition to Sayce's view which limits the term to the Gulf of Akabah, namely, the arm to the east of the Sinai peninsula. The author also identifies the present Ayûn Musa as the Elim of the exodus: this, like many other views advanced by him, is rendered eminently reasonable by his advocacy. The last chapter, entitled "Modern Events in Goshen," contains illuminating parallels from modern history to the events associated with the sojourn of Israel in Egypt, including an interesting reference to the attack on the Suez Canal during the recent war.

A Farmer's Handbook: A Manual for Students and Beginners. By R. C. Andrew. Pp. xvi+126+xliv plates. (London: G. Bell and Sons, Ltd., 1920.) 6*s.* net.

TEACHERS of agriculture would do well to take notice of this little book. It is written by a man who has had practical experience both of teaching and of farming and knows the difficulties that beset the student entering on a new subject. It is confined to the arable side of farming, and deals with the implements and processes necessary for ordinary root and cereal crops. Many common important processes are included which often miss the text-book writer's attention, such as methods of tying corn, sharpening a scythe, making a potato clamp, etc., and there is much information that is usually obtained only after painful and sometimes costly experience. The little book may be commended to the growing body of men and women interested in the cultivation of a patch of land who find themselves more and more called upon to do for themselves what was formerly done by the skilled odd man.

E. J. R.

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.*]

Biological Terminology.

DR. BATHER insists (NATURE, June 16, p. 489) that systematic zoology and botany are not wholly based on description, and gives some interesting interpretations of his own. Of course he is right—as right as if I had said that Africa is a land mass, and he had retorted that there were lakes in it. Driven by necessity, we all, even systematic zoologists and botanists, and even from infancy, practise inference and seek to make sure. We employ crucial testing when we desire to ascertain whether an explanation is true. We neglect it (*e.g.* in favour of rhetoric) when we wish merely to convince ourselves or others that it is true—as in the case of politicians, theologians, and those 262 biologists who propounded 262 explanations of sex and did not attempt to test even one. But all serious scientific interpretation is governed by very stringent rules: we must found our suppositions on verifiable facts; we must try to think of all alternative explanations of those facts; and, lastly, we must seek fresh and unlike groups of facts which shall eliminate, one after another, all the erroneous explanations. Then, and not until then, shall we have finished with mere guessing. As Uberweg puts it: "One single circumstance which admits of one explanation only is more decisive than a hundred others which agree in all points with one's own hypothesis, but are equally well explained on an opposite hypothesis."

Now, can Dr. Bather tell us of any modern sect of biologists which employs this method? It became fashionable among physicists and astronomers before Newton, and is still the very breath of their nostrils. Next it invaded chemistry—hence the rout of the alchemists. Then it captured physiology—hence the modern science. Darwin and some of his contemporaries tried to introduce it into biology. But with the passing of Darwin the impulse ceased. The new men proceeded, *unquestioned* (that is the damning point), to break every rule of scientific procedure. They coined multitudes of words that sounded tremendously scientific, but actually had no meanings in their mouths, *e.g.* germinal, blastogenic, plasmogenetic, somatic, and the like. They formulated hundreds of hypotheses, and argued about them strenuously, but—because of the vagueness of their principal terms (*e.g.* innate, acquired, inherit); because they rarely tested hypotheses and never as a body accepted a test; and because lack of crucial testing prevented the utilisation of oceans of unlike, but perfectly authentic and relevant, evidence that waited unexplored in a host of subsidiary sciences—their controversies were unending. Lastly, there happened the strangest event in the history of science. Groups of biologists, disgusted with the unceasing babble, declared that they were done with controversy, and founded the "exact" and "modern" schools. That is to say, each group, believing that a particular way of observing facts was especially modern and exact, proceeded to restrict its evidence to facts observed in that way. But, as we shall see presently, there is no especially accurate way of observing, and it is a fundamental axiom that all facts, no matter how observed, are equal before science. Again, if the area whence facts are derived be reduced, there is a corresponding reduction of evidence—of the power to discover crucial tests. Again, while controversy is unnecessary, there must be discussion, or the truth can never be established. There is a distinction between the two which implies a difference in temper. In controversy men try to belittle the facts and inferences of opponents; in discussion they candidly examine them with a view to ultimate agreement. Yet, again, "exact" and "modern" are rhetorical misnomers. This method of restricting evidence is very ancient. It has always fomented controversy, prevented discussion, and led, not to agreement, but only to the foundation and perpetuation of sects. Thus, Mohammedans have always used only Mohammedan evidence.

I am told that biologists think that I have wasted ink and paper on a subject—the method of science—which was thrashed out long ago. Certainly it has often been thrashed out; hence modern science. But never has it been thrashed out among biologists; hence the chaos in biology. As every biologist knows, his opponents, usually the majority, lack the right method; hence their incapacity to perceive the truth which to him is so plain. Anciently the scholastic thinkers founded their assumptions on unverified data and neglected to test them by fresh appeals to reality; hence the dark ages of Europe. Francis Bacon and his successors insisted that hypotheses must be both founded on, and tested by, verifiable data; hence modern thought and civilisation. But biology is still in the pre-Baconian stage. It is founded mainly on the unverified assumptions that some characters are more acquired, or innate, or inheritable than others, and, as I say, biologists rarely test their suppositions, and never as a body accept tests; hence the persistence, in great measure, of the dark ages in modern society. To-day no obscurantist dares to meddle with the established truths of astronomy, geology, or any interpretative science save biology. But he is still supreme in all that pertains to life. For example, he controls education, and, having rendered men unintelligent and trained them to unreason and passion, has recently drenched the world in blood. In England a million people, many of them innocent in every sense, are poisoned annually by means of easily preventable venereal disease, because ferocious, but ostensibly saintly, savages desire to punish sin. Yet man is a living being, and after all these years biologists should be able to tell us, with the full force of established truth, what may be achieved by education and how to achieve it. At present, notwithstanding the work of Lankester and others, biologists are impotent. However, it will not always be so. Sooner or later they are sure to fall into line with other scientific workers, and found one of the greatest and most potent of sciences.

I daresay biologists will think I am vapouring, for most of them are zoologists and botanists, and do not, almost as a point of honour, look outside their special sciences; and, while all biologists will agree that their opponents (usually, as I say, the majority) employ wrong methods of inquiry, none will believe that biologists as a class are ignorant or neglectful of the right method. Well, consider the following. Scores of similar instances may be found in literature. Once I read a book in which the author formulated suppositions of no very great importance, but which he, apparently using all the available evidence, tested carefully and established successfully. I may have been wrong in my opinion, and the author may have been superficial; but later I read a review of the book by a very distinguished biologist. He controverted not a fact or an inference; all he had to say was: "The trail of the deductive thinker is over all." But how on earth can any supposition be established except by deduction? Crucial testing *is* deduction. All interpretative science has been created by it. "If my hypothesis be true and all others wrong, then this thing, and that, and that other must be true also. Let me see if it is so." Again, I once argued with another distinguished biologist. "But isn't the evidence true?" said I. "It may be," said he; "but it's not the sort of evidence we accept nowadays!" I found that his opinions corresponded with those of the writer of the following passage, another very distinguished biologist:—

"The recognition that only by experimental methods can we hope to place the study of zoology on a footing with the sciences of chemistry and physics is a comparatively new conception, and one that is by no means admitted as yet by all zoologists. I do not wish to disparage those studies that deal with the descriptive and the historical problems of biology. . . . It is undoubtedly true that many zoologists who have spent their lives in acquiring a broad knowledge of the facts of their science fail to make use of their information by testing the very problems that their work suggests. This is owing, no doubt, to their exclusive interest in the observational and descriptive sides of biology, but also in part, I think, to the fact that the experimental method has not been recognised by zoologists as the most important tool that scientists employ . . . the essence of the experimental method consists in requiring that every suggestion (or hypothesis) be put to the test of experiment before it is admitted to a scientific status. From this point of view the value of a hypothesis is to be judged, not by its plausibility, but by whether it meets the test of experiment. . . . It is sometimes said that Nature has already carried out innumerable and wonderful experiments. . . . Let us not be blinded by rhetorical questions of this kind." And so on, and so forth.

I wonder if anyone can tell us of a passage in any sort of literature which contains more misunderstanding than the one I have quoted. "Rhetorical" indeed! *Of course*, the essence of the experimental method is *not* that every suggestion shall be put to the test of experiment. Experiment is a mode of observing, not of thinking. It is used only when the desired facts cannot be directly observed, and only for the purpose of removing the conditions which obscure them. *Of course*, physics and chemistry are advanced and accurate, not because of difficulties in observing, but only because their workers have verified both their facts and their thinking, because they have accepted all tested suppositions readily, and because they have been in a position to measure and weigh accurately. They are experimental only because, from the nature of things, most of the desired facts were obscured and could not be revealed except by some device. Physicists and chemists would not be so silly as to experiment if they could observe at sight. As a fact, nearly all their established truths started with suppositions founded on patent facts, and were tested experimentally only because of the paucity of such evidence. There is nothing sacrosanct about a fact discovered experimentally, or about a hypothesis so tested. If you twist a dog's tail experimentally, the howl you elicit is not in the least more valuable intrinsically than the tail which you observe directly. You prove a man a thief just as surely by observing the spoons sticking out of his pockets as by turning them out. *Of course*, experiment is valuable; but we need not assign it wrong values. It enables us to penetrate below the surface. But a diving dress is not the only wear. There are things worth knowing on the surface—so many things, nearly all the facts of zoology, botany, and most other biological sciences, that if they be ignored, crucial testing is impossible. *Of course*, hypotheses, founded on or even confirmed by experiment, are, like all other untested hypotheses, mere guesses; whereas all tested hypotheses, whether proved experimentally or otherwise, are in a different category: for a real test is crucial; it not only confirms the truth, but also eliminates the untruth. If literature be examined I think it will be found that when anyone insists that all suppositions must be put to the test of experiment, he really asks that we shall ignore all evidence except that revealed by experiment, and all suppositions except those founded on experiment—that, in fact, we shall grant his facts the same status and his opinions the same immunity from criticism that other sectarians (*e.g.* Mohammedans) claim for their evidence and opinions. Compare Newton, who when he found that the moon's orbit (a thing which must be directly observed) did not, as then calculated, fit into his theory of gravitation, laid aside his supposition for many years, and published it only when a fresh inquiry demonstrated an error in the first calculation. Consider the glaring truism that "Variation is the sole cause of non-inheritance; apart from variations, like exactly begets like when parent and offspring develop under like conditions." No biologist will venture to dispute that truism. Is it necessary to test it experimentally? If it be true, what becomes of the Lamarckian and Neo-Darwinian suppositions, and much besides that biologists have unendingly "tested" experimentally and unendingly disputed about?

When such freakish, partisan stuff as I have quoted can be published and applauded, is it not evident that biology must remain a tumbling ground for whimsies unless its workers discuss and agree on its rules of procedure? The rules under which other interpretative sciences have been created—that language must be precise and significant, that all verifiable facts are equal before science, that all suppositions must be crucially tested before admittance to a scientific status, and that all fully tested suppositions must be candidly accepted—are so few and simple that were they rigorously applied, then, since the evidence is so abundant, it is certain that biology would soon rank among the greatest, best established, and most useful of sciences. It is generally thought that the multiplicity and diversity of biological phenomena, derived, as they are, or should be, from so many sciences, make the task of the inquirer peculiarly difficult. Actually the reverse is the case; for, when evidence is abundant and diverse, opportunities for testing are correspondingly frequent and established truth, rightly sought, should soon cover a wide area. Other sciences halt while evidence is painfully collected; biology halts because the methods of its students are such that they are unable to use the abundant evidence already available.

Dr. Bather says *à propos* of recapitulation: "At the moment when his letter was published some of us were discussing that very question at the Linnean Society, and Sir Archdall Reid, had he been present, would have seen that the issue was far from being the simple one that he imagines." As readers of NATURE know, I am very modest and retiring. Nevertheless, if Dr. Bather will indicate his difficulties I believe I can help him. The truth is, I have, on one hand, great faith in ordinary scientific procedure, and on the other, amid vast ignorance, a knowledge of some facts which appear to have escaped the notice of biologists; for example, the truism I have mentioned, that, apart from variations, offspring tend to recapitulate the development of their parents.

G. ARCHDALL REID.

9 Victoria Road South, Southsea.

Solar Eclipse Results and the Principle of Relativity.

ON a recent occasion I read a paper before the Manchester Literary and Philosophical Society on the nature of dimensions, in which, admitting the possibility and even probability of space and time having secondary characteristics, like those suggested by Lorentz and Einstein, reasons were given for doubting whether the methods employed for finding them could be relied on, and experimental evidence, before it could be accepted, would have to be subjected to searching adverse criticism. Prof. Eddington's solar eclipse results were therefore submitted to a process essentially the reverse of his, which had for object not the confirmation of a theory, but the discovery of an empirical relation. During this process it soon became evident that the astigmatism of the cœlostat mirrors, which had given much trouble during the eclipse by distorting the star images, had also affected the field and altered the star positions. The stopping down of the objectives aggravated this evil in a double sense: first, the reduction of the star-image astigmatism makes it impossible to construct a picture of what might be called the field astigmatism of the mirrors; and, secondly, the smaller the diameter of the pencil of light rays for each star, the further apart would be the regions on the mirror from which these pencils were reflected. Therefore, if the various regions of the mirror had semi-independent tilts, the places of the stars on the plates would be affected by these tilts. If for some of the existing plates these pencils should be found to overlap, and if the star-image astigmatism is sufficiently marked, then these plates might still be used for the object for which they were taken.

Wishing, first of all, to redetermine the positions of the stars as they appeared before scale corrections had been applied in order to trace the wandering of the images, it was found that for the outermost stars 10 and 11 these negative corrections would amount to 0·45″. This in itself was a most disconcerting discovery, for the difference of displacement on which the eclipse conclusions were based is only 0·75″. It is, of course, quite impossible for the telescope tube to have altered sufficiently in four and a half minutes to produce this result, and a change of focus of the objective would have had no effect; therefore the mirror must have warped even during this short time. At Principe the passage of clouds would produce an irregular warping effect, and this would account for the unsatisfactory photographs obtained there. In order to form some idea about the nature of the field astigmatism it was now decided to estimate the tangential displacements of the stars, for these would not be influenced either by the scale corrections or by the radial displacements, but only by the mirror warpings. It was then found that stars 3, 4, and 6, which lie almost in a straight line between 5 and 10, had moved about 0·45″ across the connecting line of these outer stars. On averaging the uncorrected radial displacements it was found that a slight scale correction of about +0·0002″ had to be made, as was done by Prof. Eddington, in order to harmonise them with the Einstein estimates, the excuse in my case being that the mirror may have acquired a slight temporary concavity. If, however, there was a temporary convexity, necessitating a scale correction of, say, −0·0003″, the displacements would appear to conform to the empirical formula 1·09″−0·00022″. It will thus be seen that the use of cœlostat mirrors is not advisable where, as under eclipse conditions, rapid changes of temperature are unavoidable.

C. E. STROMEYER.

"Lancefield," West Didsbury, July 21.

MR. C. E. STROMEYER greatly exaggerates the possible effects of astigmatism of the cœlostat mirrors on the positions of the star images. He appears to consider that the pencils forming the different images are reflected from entirely different portions of the cœlostat surface. As a matter of fact, with the 4-in. lens the pencil producing the extreme star image was reflected from a portion of the mirror which had 85 per cent. of its area common to that producing the central pencil, and with the 13-in. lens (stopped down to 8 in.) the common portion was even greater.

That there was a slight astigmatism of the mirrors is not denied. Its presence was indicated by small differences in the scale and orientation constants of the plates determined in two different ways: from the right ascensions or declinations. These differences gave a measure of the amount of the astigmatism, and showed it to be very small and of very slight effect on the gravitational displacement. The question has been fully discussed by Prof. H. N. Russell (Monthly Notices, R.A.S., vol. lxxxi., No. 2, December, 1920), with the result that the conclusions deduced from the original reductions of the eclipse plates were fully substantiated and the Einstein displacement confirmed.

F. W. DYSON.

The Atomic Radius and the Ionisation Potential.

PROF. EVE'S interesting contribution to NATURE of June 30, p. 552, on the relation between the ionisation potential and the atomic radius induces me to publish certain similar ideas of mine on the same subject to which I referred some time ago before the Royal Society in some remarks on Prof. Rankine's paper "On the Proximity of Atoms in Gaseous Molecules" (Proc. Roy. Soc., February, 1921). I did not publish the results, because I desired to wait for further data. These ideas may be stated as follows:—

According to the Rutherford-Bohr model of the atom, by the radius of the atom is meant the distance from the nucleus of the outermost electron, *i.e.* the electron the quantum vibrations of which cause the radiation of the arc lines of the atom. Sommerfeld has shown that in the normal (unexcited) state the orbit is characterised by the azimuthal quantum-number unity and the radial quantum-number zero. This orbit is circular, but to calculate its radius we must know what is the field of force exerted by the central nucleus and the remaining $(n-1)$ electrons upon the vibrating electron. This is at present an insoluble problem, but Mr. S. N. Basu (*Phil. Mag.*, November, 1920) has shown that we can at least arrive at a qualitative explanation of Rydberg's laws of spectral regularity by assuming the attracting system to be equivalent to a net central charge unity, with a doublet of strength L. On the bases of this theory, if a_x is the radius of the monoquantic orbit, it is easy to show that

$$\frac{e^2}{2a_x} = -\text{energy of the vibrating electron.}$$

$= h(1s)$ where $(1s)$ = convergence frequency of the principal series of the element in absolute measure.

$= eV_x$, V_x = ionisation potential in *e.s.* units.

For the H-atom we have, according to Bohr's theory,

$$a_H = \frac{h^3}{4\pi^2 e^2 m}$$ (a_H=radius of the electron in the normal state).

$$=0.532 \times 10^{-8} \text{ cm.}$$

and

$\frac{e^2}{2a_H}=e(13.54 \text{ volts})$. Therefore for an element x with an ionisation potential of V_x we have

$$a_x = \frac{(0.532 \times 13.56)}{V_x} \times 10^{-8} \text{ cm.}$$

Thus *the atomic radius varies inversely as the ionisation potential.*

The atomic radii calculated according to this formula are, in general, smaller than the atomic radii calculated either from crystal data (Bragg) or from the kinetic theory of gases (Rankine and others). They are shown in the appended table for the sake of comparison :—

Atomic Radius.

Element	I.P.	From I.P. $a \times 10^8$	Crystal measures $b \times 10^8$	Viscosity data
H	13·54	0·530	—	—
He	25·40	0·28	—	1·08
Ne	22·80	0·33	0·65	1·01
(Horton, *Phil. Mag.*, May, 1921)				
Li	5·40	1·34	1·50	—
Na	5·11	1·41	1·77	—
K	4·32	1·67	2·07	—
Rb	4·16	1·73	2·25	—
Cs	3·88	1·86	2·37	—
Cu	7·63	0·94	1·37	—
Ag	7·50	0·95	1·77	—
Au	8·63	0·83	—	—
Mg	7·61	0·95	1·42	—
Ca	6·09	1·18	1·70	—
Sr	5·67	1·27	1·95	—
Ba	5·19	1·39	2·10	—
Zn	9·35	0·77	1·32	—
Cd	8·95	0·81	1·60	—
Hg	10·38	0·69	—	—
Tl	7·30	0·99	2·25	—
Mn	7·38	0·98	1·47	—

The values of V_x for copper, silver, and gold have been calculated from Hicks's value of the (1S) term for these elements. That for manganese has been similarly calculated from Mr. Catalan's value of (1S) for manganese (not yet published). For these data I wish here to record my indebtedness to Prof. Fowler and Mr. Catalan. The sources for the other values are quite well known. MEGH NAD SAHA.

21 Cromwell Road, London, July 13.

American and British Superannuation Systems.

I READ with great interest the article in NATURE of June 30 on the American and British superannuation systems. The selection of a satisfactory scheme of superannuation is a matter of great importance in the organisation of a public service. On the one hand, an age limit can be effectively enforced only when suitable provision is made for those who are forced to retire, and on the other the provision of a pension conditional on the completion of a full term of service is objectionable, because a public servant who retires before that period is completed is penalised by the loss of a portion of the consideration for which he has given his labour. The result is that although a man may feel that he would do better work in another sphere, and has an opportunity of doing so, he cannot bring himself to forgo the pension towards which he has already contributed some years of service.

The recent Committee of the British Science Guild on the Utilisation of Science in Public Departments considered this question, and came to the conclusion (Journ. Br. Sci. Gd., June, 1921, p. 37) that the best solution appeared to be to award at the end of every year's service a pension (or alternatively an endowment insurance) accruing at the age fixed for superannuation (or in the case of the insurance at that age or previous death), independently of whether the officer had remained in the service or not. The advantages accruing in respect of a single year's service would, of course, be comparatively small, but those for successive years would, when added together, furnish an adequate provision for the old age of officials who had served the full term, while they would be a welcome addition to the resources of those whose later careers had followed other directions.

It is essential that these benefits should be secured by public funds, and based on actuarial calculations at current rates of interest. The amounts now quoted by insurance companies are apparently calculated on pre-war rates, and are far too low.

This scheme could be adopted whether the basis of the superannuation were contributory or not.

July 19. JOHN W. EVANS.

MAY I point out, in connection with the note appended to my letter printed in NATURE of July 21, p. 651, that if only one mutual life assurance company were available the argument quoted in the leading article of June 30 would be answered, for that argument implied that dividends necessarily go to shareholders? The remark about expenses in the note leaves the point of paragraph (3) of my letter untouched, and the final sentence of the note makes me wonder whether the two-year-old American "Teachers' Insurance and Annuity Association" will grow up and prove itself to be more "philanthropic" than the selected assurance companies in England.

I am afraid that, quite unintentionally, my former letter must have seemed offensive to have justified your note to it. The hot, dry weather has been, and still is, trying to us all, *et tout comprendre c'est tout pardonner!* W. PALIN ELDERTON.

July 22.

A Novel Magneto-Optical Effect.

IN connection with the very interesting observations communicated by Dr. R. Whytlaw-Gray and Mr. J. B. Speakman (NATURE, July 14, p. 619), I should like to point out the close similarity of the phenomena which they have observed with those observed in the case of soap solutions (Proc. Roy Soc., A, 1921, vol. xcviii., p. 395; and Journ. Chem. Soc., 1920, vol. cxvii., p. 1506).

Gray and Speakman describe the formation of flexible strings or fibres in clouds of various metallic oxides, these fibres being made up of particles of colloidal dimensions which still retain their individuality. Miss Laing, in her study of gelatinisation, was led to the conclusion that such conjunction or orientation of colloidal particles forms the mechanism of gelatinisation. For instance, in a soap solution the individual colloidal particles are otherwise the same in the liquid sol as they are in the elastic jelly. In the letter referred to it is pointed out that the particles in a cloud of cadmium oxide have an exceptional tendency to form such strings, and this agrees with the striking behaviour of Svedberg's sols of the same substance in alcohol, which on standing gelatinise, but on slight shaking revert to the fluid condition, an alternation which can be indefinitely repeated.

Gray and Speakman's results are of special interest because they occur in a particularly simple system, and thus afford opportunity for studying the mechanism of this effect, which, if Miss Laing's hypothesis is correct, must account for gelatinisation, even in the most complicated systems. J. W. McBAIN.

University of Bristol, July 19.

Science and Civilisation.

CAPT. B. J. MARDEN's letter in NATURE of July 14 (p. 623) raises a question which must be exercising the minds of many of the readers of NATURE to-day. That question is: How can scientific workers collectively obtain such control of the product of their work—new knowledge—as to secure that it shall be used for the development of a better order of society out of the existing chaos? Science—knowledge—alone can create this new order and save Europe from relapsing into barbarism. If this be accepted as a true statement of fact, we are led naturally to inquire: What are the best methods to pursue to secure that science shall be so applied?

The time is now ripe for scientific workers to set to work to devise a practicable scheme which will give to science its proper place in shaping the future destinies of the world. This is one of the chief purposes for which the National Union of Scientific Workers exists. Capt. Marden's idea seems to involve a sort of international Syndicalism applied to scientific workers and to scientific work. (Those readers who know about Syndicalism only from the daily Press will find a clear exposition of the Syndicalist position in Mr. Bertrand Russell's "Roads to Freedom," chap. iii., Geo. Allen and Unwin, 3s. 6d.) Such an organisation would offer no adequate security against the tyranny of a group over the rest of the community; and a dictatorship of scientific workers might be almost as great an evil as a dictatorship of miners, or of food producers, or of financiers. We should like to urge Capt. Marden and others who may have thought out schemes for the proper utilisation of science for the salvaging of what is worth preserving in our civilisation, and particularly those who have thought them out in the light of the large and growing volume of literature on the problem of the *rôle* of the producer (whether a producer of knowledge or of other essentials) in the future society, to publish their ideas in detail.

J. HENDERSON SMITH,
Chairman of Executive.
A. G. CHURCH,
Secretary.

National Union of Scientific Workers,
25 Victoria Street, Westminster,
S.W.1, July 19.

Bees and Scarlet-Runner Beans.

IN NATURE of August 12, 1920 (vol. cv., p. 742), a letter was published from me on the behaviour of bees visiting the flowers of the runner bean, *Phasiolus multiflorus,* to the effect that almost invariably the nectar was obtained from the flower by penetrating the calyx and corolla close to the position of the nectaries, the humble bees with their stronger mandibles biting through the sepals, while the honey bees took advantage of this pioneer work of their stronger relatives.

To my surprise, this year I find no such depredations made on the blossoms, but all the numerous humble bees are getting the nectar in a legitimate way, that apparently indicated by Nature, viz. by clinging to the more open left side of the flower and intruding the proboscis beside the pistil and stamens down to the nectar at the base of the petals. No honey bees have yet been seen on the flowers, but whether because of their scarcity or by reason of their being now unable to reach the honey is not clear.

As the jasmine flower is still bitten by the humble bees, it would appear that the hot and dry season has caused the change in the behaviour of the bees towards the bean flower, probably by hardening the calyx and making it more difficult to penetrate, while causing the bloom to be less in size and depth, so that the nectar can be more easily reached from a frontal approach. HARFORD J. LOWE.

Torquay.

A New Theorem on the Double Pendulum.

THE following interesting relation is believed to be new:—

Let M and m be the masses of the bobs of a double pendulum, and let A and B be their respective amplitudes with suffixes 1 and 2 to denote the modes. Then

$$\frac{A_1A_2}{B_1B_2}=\frac{-m}{M}.$$

The negative sign merely indicates that in one mode the bobs are opposed, and it may therefore be ignored if the absolute values of the amplitudes are considered.

It is noteworthy that the product of the amplitude ratios is inversely as the mass ratio—that is, directly as the respective distances of the bobs from their centre of gravity. It is striking that the product of the amplitude ratios is independent of the lengths of the pendulums, *i.e.* independent of the relative position of the bobs and the point of support.

When the bobs are of equal mass it follows from the foregoing that the lower pendulum is divided by the vertical through the point of support into segments the ratio of which in one mode is the reciprocal of the ratio in the other mode, *i.e.* if one point of section be obverted or swung about the middle of the lower pendulum through 180°, the two bobs and the two points of section then form a harmonic range which has many well-known properties.

H. S. ROWELL.

15 Bolton Road, Chiswick, W.4, July 18.

Ochreous Flint Artefacts from Sheringham.

I HAVE recently paid another visit to Sheringham, and have again devoted my attention to the ferruginous "pan" which, for a distance of more than a quarter of a mile, is exposed in places in the base of the cliff forming Beeston Hill. From different areas of this "pan" I have taken fifteen more examples of the ochreous flints such as occur upon the foreshore exposed at low water. The specimens, as would have been clear to anyone examining the deposit intelligently, were, without question, *in situ,* and were embedded prior to the deposition of the great masses of glacial and other strata of which the cliff is composed. J. REID MOIR.

One House, Ipswich, July 22.

The Drought and Underground Water.

THE present drought affords an excellent opportunity for studying natural underground drainage in limestone (including chalk) districts. In many streams part of the flow takes place underground, but the fact cannot readily be ascertained while a surface flow continues. The flow of small streams is now so much reduced that the whole stream may be swallowed in the limestone and may reappear lower down. It is to be hoped that geologists in limestone districts will seize this opportunity to make observations. BERNARD HOBSON.

Thornton, Hallamgate Road, Sheffield,
July 22.

The Application of Interference Methods to Astronomy.

By H. SPENCER JONES, Chief Assistant, The Royal Observatory, Greenwich.

THE recent measurement at the Mount Wilson Observatory, California, with the aid of an interferometer, of the angular diameter of the star Betelgeuse has attracted much attention, and has incidentally illustrated the advantages to be derived from the application of interference methods to astronomical measurement. In view of the striking success of this application, it is somewhat surprising that the possibilities of the method have been generally overlooked by astronomers, for the principles underlying the methods are by no means new, and their application to the determination of the angular diameters of the stars was indicated by Fizeau so long ago as 1868. It is of interest to recall the exact words used by Fizeau, the suggestion being thrown out by him incidentally in a report on the Bordin prize of the Académie des Sciences :—

"Il existe, pour la plupart des phénomènes d'interférence, tels que les franges d'Young, celles des miroirs de Fresnel, et celles qui donnent lieu à la scintillation d'après Arago, une relation remarquable et nécessaire entre la dimension des franges et celles de la source lumineuse; en sorte que les franges, d'une ténuité extrême, ne peuvent prendre naissance que lorsque la source lumineuse n'a plus que des dimensions angulaires presque insensible; d'où, pour le dire en passant, il est peut-être d'espérer qu'en s'appuyant sur ce principe et en formant, par exemple, au moyen de deux larges fentes très écartées, des franges d'interférence au foyer des grands instruments destinés à observer les étoiles, il deviendra possible d'obtenir quelques données nouvelles sur les diamètres angulaires de ces astres."

Stéphan was the first to attempt the determination of the angular diameters of stars in this way. He worked out an approximate theory, based upon elementary considerations, of the interference phenomena obtained in the focal plane of an objective when a uniformly illuminated circular disc, of small angular diameter α, is viewed through it, the objective being covered by an opaque screen in which are two parallel narrow rectangular apertures. The conclusion was arrived at that, in general, a series of parallel and equidistant interference fringes would be obtained, but that the fringes would disappear if the distance apart of the slits l satisfied the relationship $\alpha=\lambda/l$,[1] λ being the mean wave-length of the light. A determination of the distance apart of the slits for which the interference fringes disappeared is therefore sufficient to enable the angular diameter of the object to be deduced. The practical difficulty arises that in attempting to determine in this way the angular diameter of a star, the loss of light due to the restriction of the aperture to two narrow slits is so great that the fringes would in general be very faint. Stéphan removed this difficulty by showing that extended apertures could be used without serious error provided that they were equal and possessed two axes of symmetry at right angles to each other, one of these axes passing through the centres of the two apertures, and that their width was small compared with their distance apart.

With the 80-cm. Foucault refractor of the Marseilles Observatory, Stéphan, in 1874, examined Sirius and other stars. The fringes were obtained, but they did not vanish even with the maximum possible separation of the slits. The least diameter measurable by this method with this instrument was $0''.16$, but from the appearance of the fringes Stéphan was able to conclude that "les expériences citées ne prouvent pas seulement que le diamètre apparent des étoiles examinées est inférieur à $0''.16$, elles montrent encore que ce diamètre est une très faible fraction du nombre précédent."

The subject was taken up again by Michelson, who, in 1890, gave a more rigid theoretical discussion of the method than Stéphan had done. Three cases of interest were examined, and the principal results obtained may be summarised thus :—

(i) If the object is a circular disc of uniform brightness, of apparent angular diameter α, the series of interference fringes produced in the focal plane of the objective when the aperture is limited to two narrow rectangular and parallel slits will vanish when the distance apart of the slits l is given by $l=1.22\lambda/\alpha$.

(ii) If the object is not of uniform brightness this relationship is modified. The precise modification for any given law of variation of brightness can be easily determined. If, for instance, the illumination falls off towards the limb according to the law of darkening observed for the sun, the relationship becomes $l=1.33\lambda/\alpha$.

(iii) If the object is a double source, with an angular separation of the components of amount α, the fringes vanish for a distance apart of the slits given by $\frac{1}{2}\lambda/\alpha$, provided that the two components are of equal brightness, that their distance apart is large compared with their separate diameters, and that the length of the slits is perpendicular to the line joining the centres of the two sources.

The method has practical application in the measurement of the angular diameters of small bodies such as planetary satellites and asteroids, and more recently of the angular diameters of stars, and also in the measurement of the separations and position-angles of close double stars or spectroscopic binaries.

The angular diameters of small bodies such as satellites are usually measured with a filar micrometer. The measurement is possible only under conditions of the best atmospheric definition, and even then the probable error of observation is relatively large, since the width of the finest spider web is comparable with the linear dimensions of the image in the focal plane of the telescope. Using the interference method, it is found

[1] A rigid mathematical investigation replaces this by the relationship $\alpha=1.22\,\lambda/l$.

that the fringes can be well observed even under conditions of poor atmospheric definition, when the use of a filar micrometer would be impossible. The method has the further advantage that as the distance apart of the slits is varied, the separation which causes the fringes to vanish can be very precisely determined, so that the error of observation is greatly reduced. With small, faint objects, on the other hand, the loss of light arising from the use of narrow slits is serious. At the Paris Observatory an attempt was made to determine by this method the angular diameter of the major satellites of Jupiter, but the light was not sufficient to render the fringes visible. Hamy, therefore, extended the theory to the case in which the slits are of a width which is comparable with their distance apart. If the slits are rectangular, of width a and distance between their centres l, the formula obtained by Michelson for the distance corresponding to the vanishing of the fringes must be replaced by

$$l = 1{\cdot}22\ \lambda/a\{1 + 0{\cdot}765\ (a/l)^2\}.$$

Michelson and Hamy used the method for the measurement of the angular diameters of the major satellites of Jupiter. Michelson, in 1891, observing with the 12-in. equatorial at the Lick Observatory, used adjustable narrow slits. Hamy, in 1899, used the large equatorial *coudé* of the Paris Observatory, and prepared a series of screens of such dimensions that their width was one-third of their distance apart ($a = \frac{1}{3}l$), the widths being calculated so that the angular diameters, α, deduced from the above formula decreased by 0″·1 with successive screens. The screens for which the fringes became least distinct were found, and by interpolation the angular diameters of the satellites were estimated to 0″·01. The angular diameters so obtained, reduced to a distance of five units for Jupiter, were as follows:—

	I.	II.	III.	IV.
Hamy	0″·98	0″·87	1″·28	1″·31
Michelson ...	1·02	0·94	1·37	1·31

The agreement between the two series is very much better than would be obtained with micrometer observations.

The method does not appear to have been further employed until the past year, when, at Michelson's suggestion, it was tried with the 100-in. Hooker telescope at Mount Wilson. In view of the advantages of the method, this seems somewhat surprising; possibly it is due to an exaggerated idea of the difficulty of the observation. Besides the application to satellites and asteroids, the method might be employed for the measurement of the oblateness of such bodies as Mercury, which have no satellites from a study of the motion of which the oblateness might be theoretically deduced, and for which micrometrical observations are not sufficiently accurate. It can easily be shown that by rotating the slits into different orientations the corresponding angular diameters are determined.

At Mount Wilson the method has been applied to the measurement of the angular diameters of stars. Theoretical considerations have indicated that the stars of largest angular diameter are to be sought amongst the giant red, or M-type, stars, such as Betelgeuse, Arcturus, etc., but that for no star is the diameter likely to exceed 0″·05, a quantity scarcely within reach even of the 100-in.

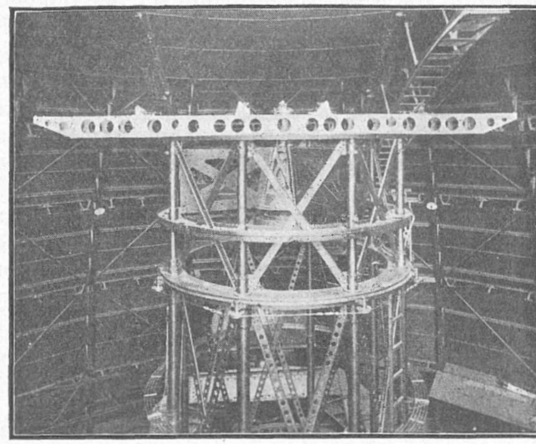

FIG. 1.—Stellar interferometer attached to end of tube of 100-in. telescope at the Mount Wilson Observatory.

reflector at Mount Wilson. Michelson, in 1890, had, however, indicated the possibility of employing the method in conjunction with an interferometer, thereby enabling the original separation of the two beams to be increased very considerably. The arrangement used at Mount Wilson is shown in Fig. 1, and diagrammatically in Fig. 2. A steel girder, LL, 20 ft. in length is fixed across the upper end of the tube of the 100-in. telescope. Two adjustable plane mirrors, AA,

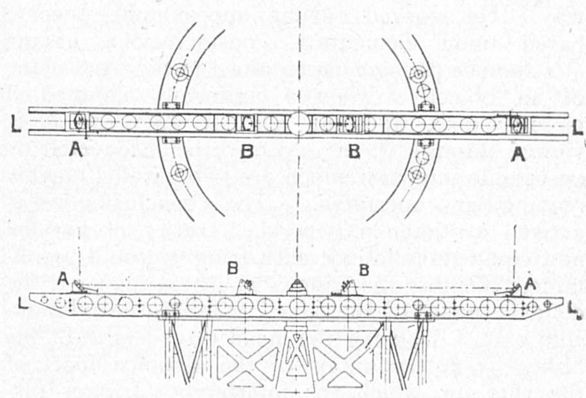

FIG. 2.—Plan and elevation of stellar interferometer.

reflect the light from a star along the girder to two other mirrors, BB, 4 ft. apart, which in turn reflect the light down the telescope tube to the mirror, the two pencils finally uniting, as shown in Fig. 3, and producing interference fringes in the focus of the eyepiece. To obtain the equality in the path of the two beams (which, for interference in white light to be observed, must be of an accuracy of 1/10,000 in.), an adjustable double wedge of glass is placed in the path of one of the beams, compensated by a plane parallel plate in the other beam. The girder is capable of rotation, so as to test whether the fringes vanish in all position-angles, thus excluding the possibility of the vanishing being due to a double source. The observation calls for a high degree of experimental skill, as all who have used an interferometer will realise, and after shifting the mirrors it is a matter of considerable difficulty to find the fringes again.

With a base line of 20 ft. it should be possible to observe the disappearance of the fringes in the case of stars the angular diameters of which exceed about 0″·02. When the telescope was pointed on Vega the fringes did not disappear even when the two adjustable mirrors were at their maximum separation, indicating that the angular diameter of Vega is less than this amount. In the case of Betelgeuse the fringes disappeared when the separation of the mirrors was 10 ft. Adopting as the mean wave-length of

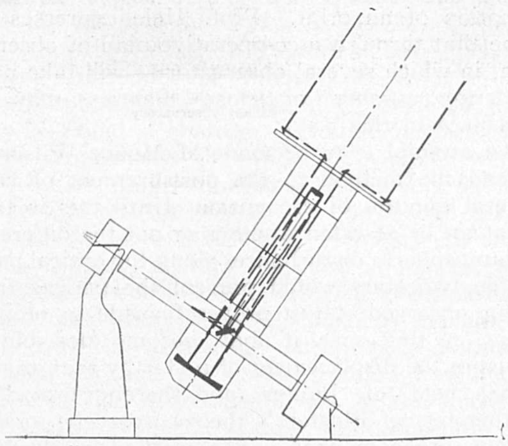

FIG. 3.—Diagram illustrating the paths of the two interfering beams.

the light 5500 angstroms, the value of λ/l is 0″·037. Assuming that there is no darkening towards the limb, the angular diameter of Betelgeuse will be 1·22 × 0″·037 or 0″·046. It is probable that the supposition of darkening according to the same law as for the sun would be nearer to the truth, and the angular diameter would then be 1·33 × 0″·037 or 0″·049. To this extent the deduced angular diameter is uncertain. More recently the fringes were found to vanish in the case of Arcturus when the mirrors were 19 ft. apart, corresponding to an angular diameter of 0″·024. This is almost the limiting angular diameter which can be measured with the present apparatus.

The number of stars the angular diameters of which exceed 0″·02 is probably not very great; according to Eddington's estimate they are to be found amongst K-type stars of zero visual magnitude, or M-type stars of zero to third magnitude. The appearance of the fringes in the case of Vega with the maximum separation of the mirrors was so distinct, however, that it is considered that interference would be obtained with a base line of 100 ft. or more; if the mechanical difficulties can be overcome, the application of the method will no doubt be extended to base lines greater than 20 ft.

The determination of the angular diameters of stars is possible only with the aid of a very large instrument. For the measurement of the separations and position-angles of close double stars, the method can be employed with comparatively small instruments, and it is in this field that the method possesses the greatest possibilities. Its advantages as compared with the use of a filar micrometer are considerable. Adopting the late Lord Rayleigh's criterion for resolving power, a double star will appear just separated in a telescope if the central image of one component falls on the first diffraction ring of the other; since with a telescope of aperture d the distance between the central image and first diffraction ring is $1{\cdot}22\lambda/d$, it follows that this is the smallest angular separation of the components of a double star for which the star will appear double. But with the interference method, as has already been stated, the fringes disappear provided that the distance apart of the slits is $\lambda/2\alpha$, α being the angular separation of the components, the fringes due to one star then falling exactly between those due to the other. The least separation which can be observed by this method, corresponding to a distance apart of the slits equal to the aperture, d, is therefore $\lambda/2d$, and it will be seen that the method increases the resolving power of a telescope in the ratio of about 2·44 to 1. Expressing d in inches, the normal angular limit of resolution is approximately $5''/d$; with the 100-in. telescope a separation of 0″·05 should be just observable with normal methods of observation, the interference method reducing this to 0″·02. That this increase in resolving power is actually obtained is proved by the observations of Capella at Mount Wilson. This star was known to be a spectroscopic binary, but visual methods had failed to separate the components, though it was established that their separation could not exceed 0″·06; it therefore provided an interesting test object. The disappearance of the fringes was easily observed with the 100-in. telescope; the distance apart of the slits when this occurs determines the separation, and their orientation the position angle of the binary. Observations secured on six nights enabled an orbit to be computed. The observed distances and position-angles, together with the residuals from the values deduced from the computed orbit, are as follows:—

Date	Distance	Residual	Position-angle	Residual
	″	″	°	°
1919 Dec. 30	0·0418	0·00000	—	—
1920 Feb. 13	0·0458	−0·00003	5·0	+0·4
,, 14	0·0451	+0·00004	1·0	0·0
,, 15	0·0443	0·00000	356·4	−0·9
Mar. 15	0·0505	0·00000	242·0	−0·4
April 23	—	—	(not stated)	−0·2

These figures emphasise the remarkable accuracy of the method (the largest residual in distance is only four ten-thousandths of a second of arc!). It is stated that with care both angular separation and position-angle can be measured with an accuracy of about 1 per cent. This accuracy is much greater than is possible with a filar micrometer. The method possesses the further advantage that the percentage accuracy in both distance and position-angle does not decrease with decreasing separation; with the filar micrometer, on the other hand, the error of observation increases considerably with decreasing separation. For the successful use of the interference method good "seeing" is not essential, whereas for the observation of close double stars with a filar micrometer very good seeing is necessary. In explanation of this unexpected result it is suggested by Hale that "in bad seeing, when using the whole aperture of the objective, there is an integrated effect of the light-waves meeting in all possible phases, which tends to obliterate the details of the diffraction pattern of the star-image, but that when two light pencils are selected at opposite ends of a diameter the result is not an integration, but a mere displacement of the diffraction-pattern, sufficiently small for the eye to follow."

If the distance between the slits is greater than the value $l=\frac{1}{2}\lambda/\alpha$, which gives a unique position for which the fringes disappear, there will be four position-angles for the slits in which this occurs, these positions being symmetrical with reference to the line joining the two components, viz. $p\pm\theta$ and $p+\pi\pm\theta$, where p is the required position-angle. The most accurate method of observation is to adjust the distance apart of the slits so that θ is about 30° to 50°, and to measure the four positions in which the fringes vanish, so determining θ and p; if the separation of the slits is l, the value to use for the computation of the separation of the components of the binary is $l \cos\theta$, the separation therefore being $\lambda/2l\cos\theta$. If three different values of l are used and the corresponding values of θ are determined, the accuracy of the observation is increased. We have heretofore supposed that the components are equal in brightness and separated by a distance large compared with their diameters. If they are of unequal brightness the fringes do not completely disappear in any orientation of the slits, but instead the positions of minimum visibility (when the fringes of one star fall between those of the other) are observed. The variation in contrast is greater the more nearly equal the components are in brightness. The method is therefore suitable for the observation of close doubles which do not differ too greatly in brightness and are beyond the limit of resolution of, or observable only with difficulty and under the most favourable conditions with the telescope available, in conjunction with a filar micrometer. The time required for a single observation is longer, but this is more than compensated by the great increase in accuracy of the observation, by the possibility of observing under poor atmospheric conditions, and by the smaller number of observations required for the determination of an orbit. Prof. Hale expresses the hope that through a co-operative plan of observation, in which several observatories will take part, a large number of close binaries may be measured in this way.

An attempt is to be made at Mount Wilson to extend the method to the measurement of stars several minutes of arc apart. Until this is tried it cannot be asserted whether or not the difference of atmospheric disturbances along the optical paths of the two stars would prevent the fringes from being observed. If it proves feasible to observe them in this case it may become possible to measure the displacement of a star by the gravitational field of Jupiter, and thereby provide a further test of Einstein's theory, scarcely possible in any other manner. The method might then also be employed for the determination of stellar parallaxes and proper motions (which depend upon the differential displacements of adjacent stars) with a smaller probable error and in a shorter time than by existing methods. The further investigation of these possibilities of the method will be awaited with great interest.

The Paris Conference of the Museums Association.

FOR an association which, during the first thirty years of its existence, has confined its meetings to cities in the British Isles, the proposal to hold this year's conference in Paris seemed somewhat hazardous. Whatever objections may have presented themselves to some members, there can be no doubt that the experiment proved a greater success than any anticipated. During the week July 11–17 the seventy delegates from national, municipal, and semi-private museums, with their president, who, by good fortune, happened to be a man of such distinction as Sir Frederic Kenyon, were received in the most cordial manner by the heads of the State Museums of Art and of Science, by the Conseil Municipal and by the directors of its museums, and by the authorities of Les Invalides, the Bibliothèque Nationale, and similar institutions. Receptions at the Louvre, the Musée d'Histoire Naturelle, the Hôtel de Ville, and the club "Autour du Monde" enabled members to become personally acquainted with many French colleagues; and visits to the numerous and rich collections of Paris, Versailles, St. Germain, and Malmaison, under the guidance of distinguished authorities, with privileges accorded only to heads of State among the lay public, enlarged the ideas of the British visitors almost beyond the limits of receptivity.

The inspiration and the actual knowledge of material and methods thus acquired cannot fail to benefit the museums and the municipalities which were wise enough to send their representatives across the Channel. On the other side of the account our French friends were good enough to admit some profit to themselves. The conservators of provincial museums in the recently formed French association were particularly pleased to see so many councillors of important cities, like Glasgow, Manchester, Hull, Carlisle, and Exeter, taking a keen interest in the proceedings and setting an example to their French brethren. Not only did the French museum officials observe with a pleased surprise that men of science and of art could co-operate to their mutual advantage, but the two camps in Paris were also (for the first time, one gathered) brought into friendly personal communication, so that the association may have begun the building of a new bridge across the Seine, from the Jardin des Plantes to the Louvre.

Among museums of interest to readers of NATURE, special mention should be made of the Musée National d'Histoire Naturelle, round the various departments of which the visitors were guided by Dr. Louis Mangin and members of his staff. It was pleasing to see how large had been the exchange of casts between this museum and our own Natural History Museum, and to recognise excellent specimens of British provenance. At the Musée Cluny Mr. De Montrémy explained the difficulties of arranging collections in a mediæval mansion, and the curators noted how successfully he had overcome them. At the Louvre the recently introduced system of guide-lecturers attracted the attention of museum administrators. Demonstrations are given in French, English, Italian, and Spanish; there are from twelve to fourteen a week at the Louvre, and a few in the other art museums of the State. To restrict numbers and defray expenses, admission is by ticket, costing 3 francs each lecture. Some of the members listened to an admirable exposition of the work of David by Mr. Rey, who is the organiser of the lectures. The wonderful collections of prehistoric archæology at St. Germain, excellently displayed, and most kindly demonstrated to the party by Dr. Salomon Reinach, were among the greatest scientific treasures, and professional curators also appreciated the visit to the workshops.

To allow for the numerous outside attractions, the proceedings in the conference room were wisely limited. Dr. Hoyle's account of the system of registration employed at the National Museum of Wales provoked a lively discussion on the contrasted merits of books, loose-leaf ledgers, and card indexes. But here the chief feature was undoubtedly Sir Frederic Kenyon's presidential address, which, while dealing with the arrangement of museums of art and archæology from a general point of view, in reference to space and design, sketched out the lines on which, in the opinion of its director, the British Museum might most advantageously be modified. The congestion to which Sir Hercules Read has of late directed public attention has to be met. Experience shows that the growth of the collections cannot be overtaken by the mere addition of buildings. Recourse must be had to the storage in accessible cases of a large part of the collections, after the example set by the departments of natural history, of prints and drawings, of printed books, of manuscripts, and of coins. For the collection of Greek vases a division into three parts will be adopted, after the plan suggested by a former president of the association eighteen years ago—namely, a public gallery instructively and beautifully arranged; a series for study by amateurs; and a stored collection accessible to specialists. This method will save much room in many departments. More room, however, must be given to ethnography, since each distinct civilisation in time or space needs a distinct room for its display. A lecture room is required; the plans are prepared, and only await the funds to carry them out. A gallery should also be devoted to temporary exhibitions. The library ought to remain as the centre, with a ring of exhibition galleries round it, and an outer rectangle of storage and working rooms. Sir Frederic Kenyon concluded by enumerating some ways in which the British Museum could help local museums, and intimated that other ways would gladly be entered on if the curators of the local museums would make their needs known.

At the receptions in the Louvre and the Hôtel de Ville, as also at the association dinner, to which many of the French hosts were invited, Sir Frederic Kenyon emphasised the international importance of the gathering. The delegates from the national and municipal museums of Great Britain might, he said, be regarded as ambassadors preaching the gospel of peaceful civilisation and cementing the ties contracted by the two allied nations in war. This meeting might prove the first step towards an international association of museums, such as had long been in the minds of some members, and was again set up as an ideal by Dr. Loir, secretary of the Association of French Museums.

It was the enthusiasm with which Dr. Loir welcomed the suggestion of a Paris meeting, first publicly made at the Havre congress of the Association Française pour l'Avancement des Sciences (1914), that enabled the idea to be realised at last. It was the work of Prof. Roule and Drs. Bruyère and Lemoine, of the Musée d'Histoire Naturelle, that facilitated the execution of the plan. But the especial thanks of the association were accorded to its secretary, Dr. Tattersall, and to Mrs. Tattersall for their strenuous labours in seeing that the most audacious and the most far-reaching enterprise of the Museums Association was carried through most happily to a successful end.

Congress on the History of Medicine.

THE Second International Congress on the History of Medicine has just been held in Paris. The meetings were well attended, and the papers were of a high level of interest, and provoked some stimulating and fruitful discussions.

The members of the congress, who numbered several hundreds, were welcomed by the Chief Officer for the Organisation of Advanced Studies in France, representing the Minister of Public Instruction, who was at the last moment prevented from attending and delivering the inaugural address owing to an important Cabinet meeting. The Chief Officer emphasised the growing recognition of the importance of the study of the history of science, and especially of the history of biological science and medicine, as a method of enlarging the horizon both of the scientific worker and of the specialised scholar. The membership of the congress, which included the deans of all the great French medical schools, bore eloquent witness to this growing interest, and it was impressive to see not only that almost every country (except our own) has established university chairs in the subject, but also that excellent work is being done throughout Europe.

In Paris, as in Vienna, an extensive museum illustrating the history of medicine has been attached to the university. The interesting museum in Paris was formally opened at the medical faculty on the opening day of the congress.

It is possible to mention only a few of the papers that occupied a week's crowded programme. Both France and Belgium were strongly represented. Dr. Singer took the chair at the first session, when Prof. Jeanselme gave an account of diets in Byzantine hospitals and convents, deduced with great skill and ingenuity from contemporary non-medical documents. Prof. Jeanselme also gave an interesting paper drawing biological deductions from the records of medieval astrological lore. Prof. Ménétrier spoke of Eutrapel and sixteenth-century medicine.

M. Polain, of the Bibliothèque Nationale, pleaded for international co-operation in the bibliography of ancient medicine. In this matter substantial British contributions are available. The publication is eagerly awaited of the very complete and trustworthy "Bibliography of Medical Incunabula" up to the year 1485, compiled by the late Sir William Osler; while Mrs. Singer's "Catalogue of Early Scientific Manuscripts in the British Isles" provides a guide, available to students, though not yet all published, to the manuscript material of this country. Dr. Wickersheimer, the scholarly librarian of Strasbourg University, contributed two most illuminating papers on fourteenth-century medicine.

Dr. Tricot Royer, the president of the first congress, which met last year in Antwerp, gave an account of the hospitals of Antwerp from the year 1000 to the present day. The publication of his volume on this subject is eagerly awaited by scholars. Switzerland was represented by Prof. Cumston, of Geneva, and by Dr. Sigerist, the newly appointed lecturer in the history of medicine at Zurich, who gave a scholarly account of Conrad Heingarter and the astrological medicine of the fifteenth century. The professor of the history of medicine from the Jugo-Slav University of Prague spoke on Czech medicine in the fourteenth century, while another member from Prague gave an account of the rich store of material for medical history provided by the surviving graduation theses of the ancient university, extending over a period of many centuries.

From this country came an interesting paper on Harvey by Sir D'Arcy Power, and an account of pomanders by Mr. Thompson, of the Wellcome Museum. Dr. J. D. Rolleston joined in the discussions. Dr. Singer contributed a fourteenth-century text of the lost work of Guy de Chauliac on astrology, and Mrs. Singer gave an account of medieval plague tractates, and produced a Catalan hymn to St. Sebastian for preservation against the plague which she and Dr. Singer had discovered still in use in the Pyrenean village of Planès.

Lack of space prevents an account of the valuable papers from Armenian members of the congress, from Venice, Madrid, Lisbon, Copenhagen, Gorinchem and The Hague, Rio de Janeiro, and many other places.

Nor was the programme confined to papers and discussions. The courteous and indefatigable secretaries, Dr. Laignel-Lavastine and Dr. Fosseyeux, had organised a series of entertainments. The congress visited the Bibliothèque Nationale, St. Germain, the Louvre, and other museums, besides a number of the more ancient hospitals, and in each case the visitors had the privilege of an address from the heads of the institutions, who showed them the chief treasures. Baron Henri de Rothschild invited them to a performance of "Caducée," the remarkable medical play now enjoying great popularity in Paris, and the week was further enlivened by an admirable concert by an orchestra of medical men at the Cercle Volney, and by a reception given by the Municipality of Paris.

All members of the congress were struck by the number and high level of the papers contributed to the congress from both France and Belgium. It is indeed remarkable that these countries, the greatest sufferers from the war, have led the way in the establishment of the Congress on the History of Medicine, and have made so conspicuous a success of the first two meetings.

Dr. Singer gave a cordial invitation for the congress to meet next year at the Royal Society of Medicine in London, and the proposal was accepted with enthusiasm.

Will next year's congress see the establishment of a chair in this subject, and the opening of a museum attached to the University?

Notes.

THE Dean and Chapter of Westminster Abbey have given consent for a memorial tablet to the late Sir William Ramsay to be placed in Westminster Abbey as part of the Ramsay memorial. The tablet will be placed immediately below the tablet erected to the memory of Hooker, the botanist. The Ramsay Memorial Committee has commissioned Mr. Charles L. Hartwell to prepare the tablet with a portrait medallion of Sir William Ramsay, and Mr. Hartwell is now at work upon the tablet.

THE council of the Royal Photographic Society has opened a fund by means of which some permanent memorial may be set up at Lacock to W. H. Fox Talbot, upon whose researches the present-day practice of photography and of photo-engraving has been built up. As president of the society, Dr. G. H. Rodman appeals to all who are interested in photography to contribute to the fund. Donations, large or small, to the memorial will be gratefully accepted and acknowledged by Mr. W. L. F. Wastell, vice-president, Royal Photographic Society, 35 Russell Square, London, W.C.1.

IT is announced that a medal, to be known as the Meldola medal, will be presented annually by the Society of Maccabæans for the most noteworthy chemical work of the year carried out by a British subject who is not more than thirty years of age on completing the work. The award will be made by the council of the Institute of Chemistry acting with one member of the Society of Maccabæans, and power to vary the conditions of award is vested in the committee of the society and the council of the institute acting jointly. The object of instituting the medal is to recognise merit among the younger generation of chemists and to perpetuate the memory of Prof. Raphael Meldola, the distinguished chemist who served as president both of the society presenting the medal and of the Institute of Chemistry. It is hoped that the first presentation will be made at the annual general meeting of the Institute of Chemistry on March 1, 1922.

THE ever-increasing demands for information regarding the vegetable resources of South Africa, its plant poisons and plant pests, have given considerable stimulus to botanical research in that country. One result has been the establishment of the National Herbarium at Pretoria, which now includes all the more important private collections in the country. It has also been decided to issue from time to time a publication, which has been named *Bothalia* in honour of the first Union Premier and Minister of Agriculture, the late General Botha, consisting of contributions from the National Herbarium. It will include descriptions of new or little-known plants, cryptogamic and phanerogamic. Workers in systematic botany will find this publication of considerable interest and value, and intending subscribers should communicate with the Chief, Division of Botany, P.O. Box 994, Pretoria. The first part is now ready for issue, and may be obtained from the above address, price 7*s*. 6*d*. post free.

AT the meeting of the Royal Society of New South Wales held on June 1 Mr. R. T. Baker, curator and economic botanist of the Technological Museum, Sydney, was presented with the Mueller medal by the president, Mr. E. C. Andrews. This medal was awarded to Mr. Baker by the Australasian Association for the Advancement of Science at the annual congress held in Melbourne last January for his eminent services to botany, particularly in regard to the Eucalypts. In addition to his work on the Eucalypts, Mr. Baker is the author of more than 100 original papers on the Australian flora, as well as of several monographs, such as "The Cabinet Timbers of Australia" and his *magnum opus*, "The Hardwoods of Australia," recently published. On the art side he has published a work on "The Australian Flora in Applied Art," a book just now in request by art designers in England and America. Mr. Baker is also the author of several monographs in conjunction with Mr. H. G. Smith, assistant curator of the museum. These, like those mentioned above, are all written for the express purpose of developing the natural resources of Australia, and so lead to extended industrial enterprise for the good of the community. The two most important of this collaboration are "The Pines of Australia" and "The Eucalypts and their Essential Oils," both of which have opened new fields for the development of the valuable assets amongst Australia's natural resources. Although Australian botany was specially mentioned by the Australasian Association for the Advancement of Science, yet Mr. Baker's work has extended into other branches of technology covered by the various sections of the Sydney Technological Museum, which, besides being a museum, is a bureau of scientific information for the commercial world around it.

PROF. ARTHUR DENDY discusses in a recent number of the *Eugenics Review* the perennial problem of human evolution. He believes that "the evidence of progress in conformity with a great general principle or law of Nature is conclusive." But evolution tends to take place in a wave-like manner, and not in a continuous straight line. There is apt to be a setback after each climax. The reason for this is partly because available stores of energy become exhausted, and the race may not be plastic enough to adjust itself to new conditions or skilful enough to tap new supplies. The line of racial persistence is one of readjustment in the light of education. "The great principle of evolution . . . consists in sacrifice and re-birth at more or less frequent intervals—sacrifice of all those accretions which have become effete or developed beyond the limits of usefulness, and rebirth by making a fresh start with a clean sheet." Man has a unique capacity for this task, since he has the gift of foresight and the power of deliberate control. But this is as yet inadequately developed. It must be developed by education—an education which will on one hand seek to utilise the available results of scientific investigation—on which are based, as Huxley said, the rules of the life-and-death game—

and on the other will recognise that the lasting and satisfying values are those of truth, love, and beauty. The address is a notable one—a wise, scientific sermon by a leading biologist.

AN account has been published (G. P. Putnam's Sons, Ltd.) of a meeting convened by Dr. Marie Stopes on May 31, in the Queen's Hall, London, for the discussion of constructive birth control. The chairman, the Rt. Hon. G. H. Roberts, M.P., spoke of the desirability of letting in daylight and securing trustworthy information; Dr. Jane L. Hawthorne urged the necessity of instructing those who sacrifice health and happiness through a rapid succession of childbirths; Dr. E. Killick Milard laid emphasis on the eugenic aspect of birth-control, not only in promoting the welfare of a sound family, but also in preventing the appearance of a bad one, and submitted that the experience of vast numbers of intelligent people who have used contraceptives has demonstrated that they are, on the whole, effective and harmless. Dr. Marie Stopes directed attention to the opening of the first birth control clinic in this country, and emphasised the far-reaching racial importance of positive, as well as negative, control. The advance of science, she said, has made it possible to present a material scientific basis with which to embody spiritual ideals. Instead of attempting the ascetic repression of mutual love, what should be aimed at is a culture of a love associated with a utilisation of available knowledge. "Married lovers should play the part of parents *only* when they can add individuals of value to the race." The interesting booklet contains a series of impressions of the meeting by the Rt. Hon. J. H. Clynes, M.P., and others. The whole forms a restrained, but urgent, presentation of the case for birth-control linked to a sound idea of marital relations.

MANY interesting suggestions for further research into the methods of fish preservation are made by Mr. H. F. Taylor in a paper contained in the Proceedings of the American Fisheries Society for the year 1920. The paper deals with "The Principles Involved in the Preservation of Fish by Salt," and it contains the results of a series of experiments made by the author and others. The purest salt obtainable is recommended for ordinary methods of salting, for the impurities contained in crude products are of much significance. Calcium and magnesium salts retard penetration and harden and whiten the flesh, accentuating the "saltiness" of dried fish. Pure sodium chloride gives a "mild and sweet" cure, but the flesh is yellowish and soft. Dry salting leads to a more efficient and rapid preservation than does the use of a strong brine. Reddening of the flesh in dried salt fish is due either to a bacillus or to a spirochæte, which organisms can be traced to "solar," but not to mined, sea salt. "Rusting" in fatty fish is due to oxidation of fatty acids split off from the fats by enzyme action. Indeed, most of the defects of fish preserved in any way appear to be due to autolysis. Saltpetre, which is sometimes used as an accessory preservative, helps in the retention of a slight pinkiness of the flesh by forming a nitroso-compound with the hæmoglobin of the blood. These are some of the very important matters now being investigated in America—privately, it should be noted, for the author despairs of any helpful research by Government institutions, and looks to the fishing industry for adequate attention to problems of industrial fishery importance.

THE problem of sex-determination in amphibia has for a long time been known to present special complexities. The evidence of R. Hertwig and others must be accepted as proving that external influences have an effect on the proportions of the sexes, and consequently, whatever be the true interpretation of this evidence, the simple rule of genetic predetermination cannot be held to apply without qualification to these animals. Intersexes have also often been observed, especially in the frog (see a recent summary by F. A. E. Crew, Proc. Roy. Phys. Soc. Edin., 1921, vol. xx., p. 236). M. Ch. Champy has lately made an interesting contribution to this subject (*Comptes rendus Ac. Sci.*, May 9, 1921). He found that by starving male newts (*Triton alpestris*) severely at the time when spermatogenesis should be active, the development of the secondary sexual characters is arrested, and the animal remains in a more or less neuter state, as in winter. In the following spring the testes of these animals are found to be replaced by bands of fatty tissue, and the secondary sexual characters do not reappear. Two such males, after being fed up in winter, were observed to undergo a peculiar transformation, assuming somewhat the coloration of the female. One was dissected on January 11, and showed only the fatty bands replacing the testes. The other was kept until April 8, and became entirely female in appearance. On dissection each fatty band was found to contain an ovary with young ovocytes, much as in newly metamorphosed females, together with an oviduct. The specimen in question had at the time of capture been an undoubted male, and reason is given for believing that it had fathered the fertile eggs of a female with which it had been paired in captivity before the treatment began.

IN the Transactions of the Royal Society of Edinburgh (vol. lii., part iv., No. 30) Mr. J. M. Wordie publishes a paper on the soundings and deep-sea deposits of the Shackleton Expedition in the Weddell Sea. The soundings were 152 in number, and were made while the *Endurance* was a free agent and during her drift in the pack until she was crushed in October, 1915. This important series of soundings amplifies the only previous work in the Weddell Sea by the *Scotia* and the *Deutschland,* and was the principal scientific outcome of Shackleton's venture. No map accompanies the paper, but Mr. Wordie points out how the soundings remove all probability of Morrell's reported landfall or Ross's "strong appearance of land" in the north-west of the Weddell Sea. However, an island is still possible, even if unlikely. The continental shelf off Coats Land, discovered by the *Scotia,* has been proved to be narrow and irregular in contour. On the west of the Weddell Sea the *Endurance* took 103 soundings in depths under 275 fathoms, and proved the existence of a series of stepped terraces with boundaries running north-east and south-west. These terraces run parallel with the eastern shore of the Weddell Sea, but at right angles to the presumed west coast. This terraced structure suggests that the Antarctic continental shelf is the result of earth-movements. The soundings of the *Endurance* were taken far west to touch the supposed deep in the Biscoe Sea, and they throw no further light on the problem of the connection of Antarctica with other southern continents. The rock-fragments obtained in the dredge, which on account of the movements of ice in the Weddell Sea probably all came from the east, tend to confirm the idea previously held that Coats Land belongs to the plateau type of Antarctica. Their evidence, however, is inconclusive.

THE Royal Geographical Society has recently issued two lists of place-names giving the spelling decided on by its permanent committee on geographical names for British official use. The first of these contains about 300 European names, and the second some 200 Asiatic names. Other lists are to follow. The aim has been to adopt so far as possible the native spelling, but in a number of cases the conventional form in use in this country has wisely been retained. The difficulty is to find a dividing line between the two systems. It is advocated, for instance, that the terminal "s" should be dropped in Marseilles, but retained in Lyons. Norwegian names beginning with a "K," like Kristiania, are spelt with a "Ch" in this list, for no apparent reason except usage. On the other hand, Gothenburg, the anglified version of Göteborg, is discarded, and Helsingör is given in place of Elsinore. It is not clear why Arkhangel should be spelt with "c" instead of "k"; the latter may not be the more usual practice, but has the advantage of expressing with least chance of ambiguity the sound of the Russian letter. Similarly Harbin, the form advocated in the list, gives the sound less truly than Kharbin. According to the Royal Geographical Society's own system of transliteration (*Geographical Journal*, January, 1921), the sound is equivalent to "kh." The correct transliteration is used in Sakhalin. It may be correct, but it will prove difficult in usage, to substitute such forms as Bosporus or Bukhara for the more usual Bosphorus or Bokhara.

THE Geological Survey has just issued the latest volume of its Special Reports on the Mineral Resources of Great Britain, dealing with rock-salt and brine, by Dr. R. L. Sherlock. The report is clearly written and very complete, reference being made to many even of the smaller brine springs existing in the country. It must be borne in mind that salt is one of the most important minerals produced in Britain, and that it forms the basis of an extremely important section of our heavy chemical trade; on this account information as to the occurrence and distribution of salt is of the greatest importance, and the Survey has done a valuable piece of work in collecting the information which has here been brought together.

DR. H. S. WASHINGTON contributes a paper of general interest on "The Chemistry of the Earth's Crust" to the Journal of the Franklin Institute, vol. cxc., p. 757, December, 1920, in which he correlates the regions of mass-defect and mass-excess, as shown by gravity-observations, with what is known of the chemical composition of the underlying rocks throughout the globe. He uses the analyses collected in the monumental Professional Paper 99 of the U.S. Geological Survey, and he finds that the rock-densities calculated from these analyses correspond well with the theory of isostasy. There is "a complete harmony between average specific gravity and average elevation everywhere," the rocks being less dense under the areas of higher land. In *Science* for March 4 C. K. Leith discusses the nature of the movements by rock-fracture or rock-flowage that occur in lower regions of the crust, and concludes that these are much like those that take place in the zone accessible to observation. Hence we need not postulate any single zone of flowage, such as Barrell's asthenosphere, and we are led towards "the Chamberlin conception of a heterogeneous structural behaviour of the earth."

DIURNAL variation in wind velocity and direction at different heights is dealt with by Mr. J. Durward in Professional Notes No. 15, published by the Meteorological Office. An attempt is made to discuss the results of pilot-balloon ascents made on the British Front in France at intervals of four hours. It is shown that winds up to a height of 3000 ft. have a minimum velocity at about noon, and the higher one goes the later does this minimum occur. At 4000 to 6000 ft. observations are generally insufficient, but there is evidence that west winds decrease by day and east winds increase. In general, a decrease in velocity is accompanied by a backing which may amount to as much as 20°. Results obtained on the same subject from pilot-balloons in Italy and in Batavia are referred to, and are said to be in close agreement.

CLOUDINESS in the United States is the subject of an article in the *Geographical Review* for April–June, 1920, by Prof. R. de C. Ward, of Harvard University. As a climatic element the amount of cloudiness is recorded by eye on a scale 0 to 10, and from observations made two or three times a day the mean annual and mean monthly amounts are calculated. In addition to this information the average number of clear, partly cloudy, and cloudy days in each month should be given. Maps of monthly and annual cloudiness for the United States have been available for the last thirty years or more, but the new maps drawn by the author have the advantage of more complete data collected and supplied by the Weather Bureau of the United States. In all, 190 stations are employed, and of these 65 had more than forty years of observations. The mean annual maps show that there are two districts of maximum cloudiness, both more than 60 per cent., one lying over most of the Great Lakes region and extending northward over the St. Lawrence Valley and northern New England, and the other on the extreme north-western Pacific coast. Both these regions are said to be under marked cyclonic control. The northern States are more cloudy than the southern, and the Pacific coast as a whole is less cloudy than the Atlantic. July and August are the least cloudy months, whilst in the southern States the minimum cloudiness is in autumn. In Florida the cloudiest season occurs during the summer months.

THE report of the National Physical Laboratory for 1920 (the first year of the directorship of Sir J. E. Petavel) records an unusually large number of staff changes. Sir A. Schuster has become chairman of the executive committee; Mr. F. E. Smith has left to become Director of Research at the Admiralty; and Messrs. C. C. Paterson, A. Campbell, A. Kinnes, B. P. Dudding, E. A. Coad-Pryor, and Dr. N. Campbell have resigned, and some of these posts have not been filled. Mr. R. V. Southwell has been appointed superintendent of the aerodynamics department. The fees for tests have been increased, and the number of instruments sent for test has decreased as compared with 1913, notably in the case of optical and electrical instruments. A large amount of work has been done for industrial research associations and for Government Departments, but in future Admiralty work will be independent of the Laboratory. The programme of work for the present year includes the measurement of physical constants required in industry and in the medical profession, the improvement of the tests for photographic lenses, the study of the characteristics of three-electrode valves for wireless telegraphy, the manufacture of length standards of high accuracy, investigations on lubrication, tests of models of aeroplanes with air-screws running, light alloys research, and investigation of the interaction of ships.

THE Bureau of Standards, Washington, has issued a pamphlet on "The Spectrophotoelectrical Sensitivity of Proustite," by W. W. Coblentz, which is now ready for distribution, and may be obtained by anyone interested by addressing his request to the Bureau. This investigation is a continuation of previous work on various substances. At 20° C. the spectrophotoelectrical sensitivity curve of proustite has a wide maximum in the ultra-violet, with a weak, ill-defined band at $0 \cdot 6\mu$. By cooling with liquid air the intrinsic sensitiveness is greatly increased, and there is a very large development of this band, which now shows a maximum at $0 \cdot 578\mu$.

Our Astronomical Column.

THE AUGUST METEORS.—Mr. W. F. Denning writes:—"This annual shower returns to a maximum on about August 11, and the circumstances are rather favourable this year, the moon being near her first quarter and setting at 11h. 19m. G.M.T. There is no reason to expect an unusually abundant display, but it will be sure to provide an interesting shower of bright, streaking meteors. The larger objects should be carefully recorded, so that their real paths may be computed. The position of the radiant point and its change of place ought to be determined on each night when the atmosphere is clear enough for the purpose, for the shower is already fairly rich at the end of July, and is well maintained until the middle of August. This date, however, does not limit its duration, for occasional meteors are seen towards the end of the month. The morning hours are usually best, for the radiant is at a greater altitude after midnight than at an earlier period. Though this system of meteors has been sedulously observed during a great number of years, there is still much to be learnt concerning its annual variations, date of maximum, changes in the position and character of the radiant point, and in the relative strength of the numerous contemporary showers which are visible."

SEARCH FOR METEORS FROM THE PONS-WINNECKE RADIANT.—Prof. Barnard reports that he watched for meteors all night on June 24, 25, 26, and 27; although the search was fruitless it has considerable negative value as showing that the dense part of the meteor swarm did not intersect the orbit of the earth, so that it would appear probable that the shower of June, 1916, will remain the sole example of a shower from the Pons-Winnecke radiant.

Mr. R. G. Chandra, of Jessore, India, also reports a fruitless search for meteors on the night of June 25. He states that Prof. Ray, of Bolpore, saw two meteors radiating from the neighbourhood of θ Boötis.

Prof. Barnard mentions a telephonic report of a shower lasting ten minutes on the night of June 27. No further particulars were available.

STATISTICS OF PROPER MOTIONS.—No. 30 of the Publications of the Astronomical Laboratory at Groningen, by Prof. J. C. Kapteyn and Dr. P. J. Van Rhijn, is a continuation of the valuable studies in stellar statistics that have appeared in this series. It commences with a *résumé* of recent catalogues and other sources of our knowledge of proper motions, such as Mr. Innes's researches with the blink microscope. The question of the effective area of the sky covered in each research is considered—that is, if a catalogue is not exhaustive down to some assigned magnitude, it is considered to be exhaustive for a smaller area of the sky, determined by the number of stars contained in the catalogue.

One of the most interesting questions dealt with is the number of stars in the whole sky with motion between certain limits. The following table has been formed from data in Tables 6 and 7 of the book. For these large proper motions the distribution is shown to be independent of galactic latitude.

Limits of Proper Motion.

No. of stars in whole sky.	0·2″	0·3″	0·4″	0·5″	0·6″	0·7″	0·8″	0·9″	1·00″	1·50′	2·00″
Mag. 6	169	71	30	26	16	7	5	3	14	1	5
7	304	120	56	61	40	23	12	6	13	3	3
8	520	216	76	124	36	21	21	11	18	6	12
9	1125	410	103	38	47	25	34	13	51	21	9
10	1425	261	166	133	48	29	24	10	33	10	19
11	1770	342	200	135	63	117	45	36	90	9	0
12	1770	450	450	68	45	23	23	90	113	45	0
13	1620	690	400	225	135	23	113	45	23	23	28
14	1490	800	350	158	68	113	45	0	0	0	0

The 169 in the first line means that there are 169 stars in the whole sky with annual proper motion between 0·2″ and 0·3″ and magnitude between 6·0 and 6·9. Similarly in other cases. The figures for the faint stars are rough, since they are deduced from the examination of very limited areas.

The Universities and Technological Education.[1]

By PROF. A. SMITHELLS, F.R.S.

NEARLY three centuries ago Robert Boyle came to Oxford aglow with zeal for the pursuit of chemistry, a study which he was the first to establish as a science and to endow with the title of a philosophy. His work, it appears, aroused bitter animosity; he was attacked in the University pulpit for his theories and their corrupting influence; above all, indignation was felt that he, a gentleman by birth and position, should concern himself with low mechanical arts.[2]

If times had not greatly changed, the prospect of those coming here to-day to proclaim the University rights, not of pure science, but of technology, would indeed be cheerless. But times have greatly changed, and whilst, as the centuries have passed, the best of the ancient ideals that dominate this illustrious seat of learning have become more precious and inviolate, and whilst the chief glory of the University still lies, I suppose, in the realm of ancient studies, there has been so wide an expansion of intellectual sympathy that to-day natural science is in brilliant display, and technology itself is not only condoned, but in a measure also practised here.

It is no part of my purpose to urge upon Oxford an extension of this latest province of her work. It would be an impertinence, even if I felt eager, as I do not, to suggest it. But I hope it will not be an impertinence to make into something of a text the historical facts just recalled. I have always thought that our difficulties with technology have arisen chiefly from the belated and stinted cultivation of natural science in the ancient universities. For it is they that have to so large a degree given the law intellectual and set the currents of our education. If natural science as it arose had been gathered to the older studies and had flowed in its natural courses, the mechanical arts and those who follow them would surely have been brought long since into a very different relation with the academic world.

Those arts which are first in importance to hungry, naked, and pedestrian man were the last which man learned to imbue with rationality. The succeeding arts, which regulate communal life, gave birth to professions that soon became learned; the economy and safety of communal life gave leisure for the disport of fancy; and so it happened that when the range and achievements of man's intellect in the pursuits that relate to human intercourse and to the imagination had already reached such magnificence as to send illumination down the ages, the science that intellectualises the mechanical arts was only just emerging from the close concealment of its material garb. The early promise soon was blighted, and natural knowledge languished through the Middle Ages, leaving industry to make its progress in the light of art, but in the gloom of empiricism.

When at last science took on rapid growth, when the stir of invention quickened the pace of humanity and we entered upon the riot of the industrial age, there ensued a period lasting until now when industry has been struggling, consciously and unconsciously, for its intellectual rights, lacking most grievously the sympathy, the prevision, and the leadership that should have been forthcoming from the established centres of educational influence, the universities. And so we find ourselves in a land that has been forced to provide for itself as it could its bread-and-butter studies, its rations of useful knowledge dealt out to the toiler when his day's work is done, its technical schools, commercial academies, colleges of science, and I know not what else, standing outside and in the shade—improper still, I think, in many minds to what is education proper. We are not to blame those who have been busy in this work. "Necessity has no law, and expedience is often one form of necessity. It is no principle with sensible men of whatever cast of opinion to do always what is abstractedly best. Where no direct duty forbids we may be obliged to do, as being best under circumstances, what we murmur and rise against as we do it. We see that to attempt more is to effect less; that we must accept so much or gain nothing; and so perforce we reconcile ourselves to what we would have far otherwise if we could . . . it may be the least of evils . . . it may be professedly a temporary arrangement; it may be under a process of improvement; its disadvantages may be neutralised by the persons by whom or the provisions under which it is administered."

But we live in a time when we are forced as never before to consider our ways, to look beneath the surface of things, and to take thought for the future. It is a time when we must go back to principles and consider what, in Newman's words that I have just quoted, is "abstractedly best," a time when we may be excused for aggressiveness in asserting the fundamental principles of our faith.

Speaking in terms of our subject to-day, we may say that we find ourselves a people far spent by the cost of victory over a nation of technologists, a nation which had carried to the highest point the training of its people in applying exact knowledge to the mechanical arts of both peace and war, the knowledge that enabled it under stress to make gun-cotton from wood and air, to conserve its fats for food by making glycerine from starch, to fire a shell seventy-five miles, and to do a great many other marvellous things in the mastery of matter. I have not heard of any direction in which our late enemies could be charged with faults attributable to a neglect of technology. On the other hand, there is abounding evidence that without it they would have been defeated in a year. The tale of the forced march of our own technology in this war of chemists and engineers has not yet been fully told, and perhaps its triumphs are only dimly understood.

In the face of all this it would be excusable perhaps to make this the occasion to preach the urgency of technology. But that is not my intention; I am far more anxious to raise my voice against its unbridled pursuit, to direct attention to the restraints under which it should be fostered, and to plead for what seems indispensable to its worth.

Whatever may have been the ultimate source of German decadence, it has proceeded step by step with changes of outlook, of aim, and of organisation in education that were of melancholy significance to those who had any knowledge of the Germany of old. The reproach was not in their becoming a race of technologists, but in their education from beginning to end yielding to the domination of a spirit which set above all else the worship of power and material efficiency. Surely the supreme educational lesson of the war is that we teachers should stand shoulder to shoulder against all the forces that tend to the vitiation of the atmosphere of education and to the desecration of our temples of learning.

1 From a paper read before the Congress of the Universities of the Empire at Oxford on July 6.

2 Prof. H. B. Dixon, Address to Section B, British Association Reports, 1894 (Oxford), p. 596.

Unaltered as is my eagerness for the promotion of technological studies and undiminished my belief in their university rights, I can therefore, and do at the present time, listen at least with patience to alarmist voices more than hinting at the elimination of technologies from our universities. It is more grateful to the ears than some other prescriptions coming from advisers who would act on the precept that it is lawful to learn from the enemy, but would, it seems, have us learn just the wrong thing.

But we must be careful not to be thrown off our balance by a laudable emotion. It is perfectly certain that our national circumstances require, and will require in an increasing degree, the application of the highest knowledge to the industrial arts. An increasing proportion of those endowed by Nature with the best brains and the strongest elements of character will be absorbed by industry, simply because the maintenance of industry is a condition of existence, and its maintenance becomes more and more exacting of both mind and character.

The tendency of those who are so susceptible to anything that seems to threaten a depreciation of university life to say, "Let industry have the brains it wants, get them trained how it wants, and where it chooses—*anywhere but here*," seems to me a fatal closing of the eyes to what is written in blood on the pages of recent history.

Not less wrong, in my opinion, are those who still maintain that the universities have done their whole duty when they have provided the unspecialised studies that are fundamental to industrial science. We know, indeed, that these are all-important, and that men well trained in them, if properly used, will learn elsewhere in the end effectively to apply them. But that there exist ranges of special knowledge, essentially high science, lying between the abstract sciences and the mechanical arts, and that a training in this knowledge may be organised to great advantage in teaching institutions, will not be disputed by anyone who has regarded the evidence at hand. Certain it is that these so-called technologies will be taught somewhere, just as the specialised high studies of theology, law, and medicine are taught, and where they are taught well, there will they be sought. They will be sought now as never before, and what appears to be the matter most needing consideration in our discussion to-day, the point on which I wish to focus attention, is this: that unless the universities collectively embody enough high technology to meet adequately the prospective demand, we shall inevitably cast a large section of our best industrial manhood into institutions wholly devoted to one type of studies and dominated by aims which, however worthy, are directed to the object of immediate material utility.

I cannot believe that any thoughtful Englishman can now regard such a prospect with equanimity. He has surely realised too well the functions of a true university, and what we must exact from it for the education of our race: that it must be, above all, a centre of life in which we secure the influences that will regard and tend the idealism of youth, that will bring into good fellowship and sympathy young men coming from all quarters, cherishing every kind of healthy interest and going out into the world to every kind of legitimate pursuit. It must be a community where traditions of honour and high aims are created and impressed, and where no study is at home that is not fraught with a continually disinterested exercise of the mind.

"It is pledged to admit," says Newman, "without fear, without prejudice, without compromise, all comers, if they come in the name of Truth; to adjust views, and experiences, and habits of mind the most independent and dissimilar; and to give full play to thought and erudition in their most original forms, in their most intense expressions, and in their most ample circuit. Thus to draw many things into one is its special function."

It must be, in short, the place that Milton conceived as giving the "compleat and generous education that fits a man to perform justly, skilfully, and magnanimously all the offices both private and publick of Peace and War."

It is in such an environment surely that we must educate as many as we can of those who are to be the guiding spirits of the working world.

It has, I believe, seemed to many of us here, and certainly to some in the country itself, that the technological universities of Germany, the much-vaunted "*Technische Hochschulen*," have, in the field of education, been strikingly symbolic of a change of spirit in that nation. True it is that they have not usurped the very name of "university," but they made pretensions and acquired prestige and powers that in effect gave them an equal place, or even a prior one, in the esteem of their country. The German, it is true, has never abandoned his formal homage to the older university ideal, just as he has maintained in external form, over much of his educational system, the discipline of what are called "humanities." We have found the modern German still in a way informed in things intellectual, moral, and æsthetic, but we have felt that this equipment was becoming more and more a conventional outer garment, according less and less with the spirit it enveloped.

Nothing has happened that can rightly lead the Germans to relax their cultivation of technology, but among the signs of their regeneration we shall surely look for the return of a true allegiance to their older ideals of universities and all they must stand for in the scheme of a truer civilisation. They must acknowledge that there is something in university life transcending in importance the achievement of efficiency, and that the first care of the nation should be to see that its education proceeds where influences prevail that will touch the spirit of youth to right ambitions and ideals of life. Among the excesses of regimentation the Germans have, I think, good cause to reconsider their educational plan of isolating seminaries of technology.

If thus, in the light of recent history, I am brought to plead more earnestly than ever for the ranging of this set of studies for their own sake within the university, it is in no spirit of condescension or without a strong conviction that they have much to give as well as to gain. It has been my own fortune to live in a university which, perhaps more than any other, has made ventures in the domain of technology and has sought to bring into an articulated and harmonious whole, without preference or priority, without caste social or intellectual, on equal terms and with equal rights, the studies, teachers, and students concerned with both professional and industrial occupations. I do not know that there is one among our teachers who would not acknowledge advantage from this association and bespeak from it, when rightly achieved, a broadening rather than a narrowing influence on the best elements of university life.

I hope I am not insensible to the safeguards that must be observed. A tendency to extravagance lies in every new movement, and in relation to technology it is most important that there should be restraint of ill-considered plans. These safeguards I endeavoured to outline when speaking on this theme at the congress nine years ago. It is perhaps permissible again to urge that the universities should observe a due proportion and economy by differentiation in their technologies according to the natural homes of these, that they should study co-operation in policy and encourage interchange of students. More important still as an actual need of the day seems to be this: that universities which associate themselves with technological institutions of originally independent growth shall bring the studies, teachers, and students effectively into the precincts and life of the university. Equally important does it seem that this should be done so far, and only so far, as these studies, teachers, and students can be rightly regarded as conforming to the standards of a university. It is to be feared that there lie here practical problems of grave difficulty, and that we may be entering upon a troubled time. The difficulties for the universities lie mainly in the suspicion, which they so easily incur, of possessing all those failings that are apt to beset aristocracies, and when they are prescribing restrictions in the light of experience and with a disinterested desire for the common good, they may easily enough be regarded as acting merely in a disdainful spirit of exclusiveness. Another danger, of course, lies in an eager spirit of accommodation, a disposition to please the multitude, and a love of peace, amid which essentials may be sacrificed to gain the mere semblance of success.

In the restlessness of our present world it is difficult to gauge the currents of opinion that will mould or remould the institutions of our country. But so far as education is concerned it seems clear that, if we are to accept their spokesmen, the rank and file of the teeming world of labour have set their heart in something like clear purpose to the ends that shall be sought. They will not have it that their new and increased education shall be permeated and dominated by a sordid or material aim. They begin to suspect the agencies that make their chief promise a cleverer performance of the daily task or the earning of a larger wage. In their revulsion from such an object they threaten to repudiate what in truth in its proper place, among other things, will lighten and enlighten their labours.

There is no sign of the times that to me seems more hopeful, for I see in it the promise of an end to the far-reaching and incalculable mischief that has come of a false distinction between useful and useless knowledge. But there are opposing forces to contend with.

It seems to me that there is no service of universities more needed now than to exhibit in the centres of highest education, which can so easily lead the way, the true intellectual nurture of industrial life—the embodiment of technology in full and fruitful fellowship and interplay with accepted liberal studies.

New Apparatus for Showing the Tracks of α-, β-, and X-rays.

It will be remembered that Mr. C. T. R. Wilson described his original cloud expansion apparatus as used for showing the tracks of α- and β-rays and of X-rays before the Royal Society in April, 1911, and at that time the Cambridge Scientific Instrument Co., Ltd. (now the Cambridge and Paul Instrument Co., Ltd.), took up the manufacture of this apparatus. The manufacture of apparatus of this class was, however, entirely stopped by the war.

Lately Mr. Takeo Shimizu, of Japan, working at the Cavendish Laboratory, Cambridge, has considerably modified Mr. Wilson's original apparatus, and the Cambridge and Paul Instrument Co., Ltd., is now putting the improved design upon the market. In Mr. Wilson's original apparatus only a single expansion was obtained. It was thought to be necessary to give a comparatively rapid expansion in the working chamber, and this was obtained by connecting the space under the moving piston to another space which was previously evacuated. The moving piston was, in consequence, suddenly sucked down against a rubber stop. Mr. Shimizu has found that the sudden expansion is not necessary, and has, therefore, arranged for a reciprocating piston, and he obtains cloud tracks of the rays at each expansion, which may be timed to occur at rates from about 50 to 200 per minute. The instrument thus designed is extremely simple, but there are several important points to which attention must be given for successful operation.

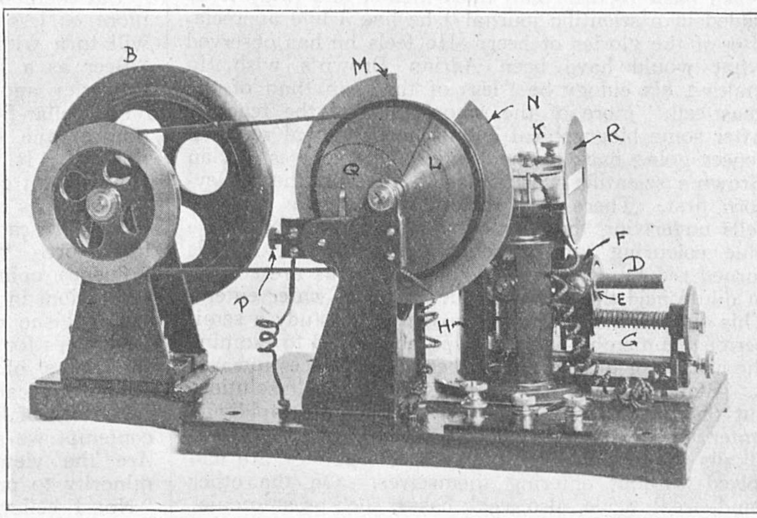

FIG. 1.—Shimizu expansion apparatus.

The apparatus is shown in Fig. 1. The crank (not seen in the illustration), which is driven either from the hand-wheel B or by means of a small motor, drives an upright connecting rod, which in turn drives a horizontal connecting rod D. The far end of D slides in a sleeve E, which is free to rock in the piece F. The piece F can be adjusted in a horizontal direction by means of the screw G. The piston-rod H is connected near the middle of this latter connecting-rod. Since the crank is of constant length, the horizontal adjustment of the piece F alters the length of the stroke given to the piston-rod H. By this means the expansion ratio at each stroke in the working chamber K can be adjusted while the instrument is in operation.

In order to obtain a good picture of the rays which become visible at each expansion by the formation of linear clouds on the ionised particles in the ray tracks, it is necessary that these clouds be dissipated during the compression stroke. This is done by forming a vertical electrostatic field in the expansion chamber. The upper glass plate of the expansion chamber, through which the tracks are observed or photographed, is covered on the inside with a gelatine film, which is made conducting. This film is charged negatively with reference to the metal piston, but by means of the commutator L, which rotates with the driving crank, the plate is discharged just before the occurrence of the cloud formation. In the same way as the expansion ratio can be adjusted while the instrument is running, so the length of the period during which the electric field is cut off can also be adjusted while the instrument is running by means of the screw P, which traverses the contact brush along the commutator L, which is shaped, as will clearly be seen in the illustration, in the manner required to give this adjustment. Also rotating with the crank are two adjustable lead segments, M and N, which can be used as shutters for admitting X-rays to the expansion chamber at the proper intervals. It is on the back of the disc carrying these segments that the commutator L, above described, is fitted.

The expansion chamber is fitted with a small tube, by means of which radio-active matter can be introduced into the chamber for the production of α- or β-rays. The present chamber is made 55 mm. in diameter, which is, of course, less than the length of the tracks of some of the α-rays in air, but the velocity of the α-rays can be reduced by passing them through a mica screen. A small screen can also be placed on the piston to cut off the α-rays, except at the moment of greatest expansion. The expansion chamber must be perfectly airtight, as the minutest lag produces eddy currents, which at once destroy the tracks. The instrument is very quickly set up and easily operated, as a few expansions serve to filter out any dust originally in the air. The piston forming the floor of the expansion chamber is covered with a comparatively thick layer of gelatine containing about 10 per cent. of Indian ink. This gives a good black background, against which the tracks show up brilliantly. For demonstration purposes a Pointolite lamp gives excellent results, but for photography a rather more brilliant lamp is desirable. The apparatus is illuminated by means of a parallel beam of light coming in on the left-hand side. The screen R cuts off all light, except a small rectangular pencil passing through the middle of the expansion chamber.

Mr. Shimizu has taken some stereoscopic pictures on kinematograph film with his original apparatus, and by means of these stereoscopic pictures the exact paths of the particles in space can be calculated. The Cambridge and Paul Instrument Co., Ltd., hopes shortly to bring out a suitable stereoscopic camera as an accessory to the expansion apparatus.

Scientific and other Aspects of Beer.

ADRIAN BROWN, the first professor of the first established university school of brewing in this country, died nearly two years ago, and no one more suitable than Prof. Armstrong could have been chosen to pay a tribute to his memory.[1] Prof. Armstrong's enthusiasm for the application of chemistry to biology is undimmed by age; his memories and friendships reach back further than most men's, and (may it be added in a scientific journal?) he has a fine appreciation of the glories of beer. He feels he has observed what would have been Adrian Brown's wish, in making his eulogy be "less of the man than of the yeast-cell," more of the school than of the teacher. After some biographical details and personal reminiscences going back to the 'sixties, he discusses Adrian Brown's scientific work, placing that on the barleycorn first. There is a variety with a blue layer of cells underlying the thin outer skin of the corn; the blue colouring matter behaves like litmus, and is turned red by acids; yet when the grains are soaked in dilute acid they remain blue, for only water enters. This discovery enabled Adrian Brown to study a semipermeable membrane in a living object and to examine the behaviour of a large number of substances towards it. Water is absorbed from a saturated salt solution, but the more dilute the solution the more rapidly is water taken up. Sugar, strong acids, and strong alkalis also give up the water in which they are dissolved without entering themselves. On the other hand, weak acids, also weak bases, such as ammonia, and chemically neutral substances, like alcohol and chloroform, readily pass through the membrane. Prof. Armstrong suggests that only the simple "hydrone" molecules of water, which alone are considered by him to have the formula H_2O, penetrate the membrane; complexes like H_4O_2 and H_6O_3 are held back. Cane-sugar is held back by the membrane of the barleycorn, yet it passes through the walls of the yeast-cell!

[1] Adrian Brown Memorial Lecture, "The Particulate Nature of Enzymic and Zymic Change." By Henry E. Armstrong. Delivered at Birmingham University on February 18. (Journ. Inst. of Brewing, 1921, vol. xxvii., pp. 197–260.)

Brown's investigation of the oxidative action of *Mycoderma aceti* and *B. xylinum* leads Prof. Armstrong to an account of Bertrand's work on the bacterial oxidation of sugars; similarly his researches on enzymes lead to a review of older and newer work on heterogeneous catalysis, the kinetics of enzyme action, and the mechanism of alcoholic fermentation.

But chemists who know the lecturer and are already more or less acquainted with the ground he covers will turn with the greatest interest to the section on "Beer as a Dietetic." Fortified by quotations from Calverley and from Prof. Saintsbury's recent "Notes on a Cellar-Book," he inveighs against State regulation of the brewing industry and against prohibitionists. It may have been stern necessity, but Government control has rendered beer "little short of worthless as a drink." Lord D'Abernon's committee does not escape, and is accused of verbal quibbling in its report. "The most malign of the attempts to influence opinion is probably that of the Board of Education, in the form of the syllabus of 'Lessons on the Hygiene of Food and Drink for Use in Schools and Notes for the Assistance of Teachers,' issued over the name of Sir George Newman." Later Prof. Armstrong calls out: "Is all æsthetic pleasure to be taken out of life? Are we to treat our food with the contempt we show to the coal we cast upon the fire? Are the views of an entirely selfish, unthinking minority to prevail?" And then comes his answer: "No, I believe our philosophy to be summed up in the familiar lines:—

Man wants but little here below,
But likes that little good."

After this we go back once more to science, to a historical review of the science of brewing. The debt we owe to Pasteur is sympathetically explained to a general audience, but those who are already acquainted with the work of the great Frenchman will perhaps learn most from the survey of the "Burton period" and the author's reminiscences of Henry Böttinger, Horace and Adrian Brown, Peter Griess, and O'Sullivan. This chapter in the history of English chemistry, or rather of chemistry in England—for the Browns are the only Englishmen in it—should be read by the younger generation of to-day. Two photographs show us the now unfamiliar features of Griess and of O'Sullivan.

Finally, Prof. Armstrong gives us his views on the best methods for promoting biological inquiry and on the research scheme of the Institute of Brewing. Much of what he says about this is of wider application, and bears on scientific research in general. His views, expressed with great conviction, should be especially considered at the present time, when all kinds of new research schemes are being started. Some of us cannot always agree with Prof. Armstrong, but we must all recognise that, if provocative, he is stimulating; if a fighter, he is sincere. And he is also picturesque; he does not bore us. Hence this memorial lecture derives a personal interest from the author no less than from his subject, and thereby its value has been increased.

The Ancient and Modern Inhabitants of Malta.

AT a meeting of the Royal Anthropological Institute held on June 28, Mr. L. H. Dudley Buxton read a paper on "The Ancient and Modern Inhabitants of Malta." The paper was a summary of the results of a small anthropological expedition from Oxford which visited Malta in the winter of 1920–21. The expedition was made possible by the generosity of Sir Alfred Mond and by a grant from the Mary Ewart Trust. The work in the island was offered every facility by the Governor, Field-Marshal Lord Plumer, and his staff, and Prof. Zammit, the Rector of the University, put his unrivalled knowledge of all things Maltese at the service of the expedition.

The history of Malta is bound up with its geographical position, lying as it does on a buttress of the old land bridge between Africa and Sicily. The cave of Ghar Dalam, which is being explored by Mr. Despott, may throw considerable light on man's early history in the island. At present, however, the earliest large collection of human remains belongs to the Neolithic, or more probably Æneolithic, age of the great Maltese megalith builders. Although this culture is, to a certain extent, unique, it offers possible comparison with the *allées couvertes* of Western Europe. The site of Bahria, which has not yet been properly excavated, may provide a link between the Neolithic and the Bronze ages, remains of which have been discovered actually on top of the Neolithic remains at Hal Tarxien. The following periods, the so-called Phœnician or Punic, show a close connection with North Africa—a connection which was not broken until the Roman occupation. At the division of the Empire in A.D. 395 Malta was allotted to Byzantium, to which it belonged ethnologically. It was held successively by the Arabs and by the various occupants of the throne of Sicily until handed over by Charles Quint to the Knights of St. John of Jerusalem in 1530. The Knights held it until 1798, when they were dispossessed by Napoleon. It was occupied by the British in 1800, and formally annexed in 1814.

The megalith builders appear to belong to what is generally known as the Mediterranean race. They show close affinities to the inhabitants of North Africa and Sicily. Probably at the close of the Bronze age—but the exact line is as yet uncertain—a crucial change came over the population and a new type of folk appeared, the contour of whose cranial vault suggests Armenoid characters. In spite of the constant infusion probably of North African blood in Punic times and of Italian during later periods, this type has survived in the islands of Malta and Gozo until to-day.

A study of the modern people shows several remarkable facts: first, that though there are significant differences between the Maltese and the inhabitants of Gozo, there is practically no difference between the inhabitants of the urban and rural districts taken as a whole. The inhabitants of Valetta and the suburbs, contrary to expectation, do not show more variation than the country districts. Two villages, Zurrico and Siggewi, each taken singly, showed as great, if different, variations from the urban districts as did the men of Gozo from those of Malta, but here again the people of tiny and, to a large extent, endogamous villages were only slightly less variable than those of a cosmopolitan port.

It may be said then that, generally speaking, and subject to certain reservations, the Maltese present a well-marked racial type—unlike their nearest neighbours except in Neolithic times, and much more alien to the Cretans and the inhabitants of the "Islands of the Sea."

The Rothamsted Experimental Station.

VISIT OF COUNTY AGRICULTURAL COMMITTEES.

ON Friday, July 15, representatives of the county agricultural committees and directors and principals of the agricultural colleges visited the Rothamsted Experimental Station at the invitation of Lord Bledisloe, chairman of the Lawes Agricultural Trust Committee, and Dr. E. J. Russell, director of the station. They were met by Sir David Prain, Prof. H. E. Armstrong, of the committee of management, and Messrs. T. H. Riches, Leonard Sutton, and other members of the Council of the Society for Extending the Rothamsted Experiments. No more representative party has visited Rothamsted since the great jubilee celebrations of 1893, after fifty years of work had been accomplished. The visitors inspected the plots and the laboratories, and saw practically the whole of the work which is being carried out.

The Rothamsted Experimental Station has expanded considerably during and after the war, and it now has a permanent scientific staff of twenty-six members, in addition to skilled assistants for records, library, and office, and an outdoor staff for the farm and experimental plots. The scope of the work has expanded, and now includes the soil and the growing plant in health and disease. In the main the work falls into two great divisions, carried out respectively in the laboratories and in the fields, with the pot-culture house serving as a close link between them.

In welcoming the visitors Lord Bledisloe stated that this gathering was typical of many which it was hoped to arrange in future years, and its purpose was to make the work of Rothamsted known to those most intimately associated with the development of British agriculture. The most hopeful method of helping the farmer was to furnish him with knowledge about the crops and soils with which he has to deal, and to carry out tests which he could not possibly do for himself. Lord Bledisloe referred particularly to some of the recent Rothamsted experiments, showing that the addition of chalk to the soil caused so marked a disintegration that the drawbar pull on the tractor was reduced from 1500 lb. to 1300 lb. for the three-furrow plough, thereby reducing the consumption of fuel and the wear-and-tear.

Sir Daniel Hall described the relationships between research stations and the college and farm institutes on the one hand, and the county advisers on the other. He impressed upon his hearers the fact that much of the work of an experimental station could have no immediate practical application, and yet it was absolutely essential for the development of agricultural science and for further advances in agricultural practice. He described the great changes that had taken place in the past fifteen years in the attitude of Government departments towards research work, and to the broader and more enlightened outlook on the part of the general public.

Dr. Russell described the work of the station, and emphasised the fact that its purpose is first to obtain trustworthy information about the soils and growing plants, and then to put this information into such a form that teachers and experts can use it. Among recent developments to which Dr. Russell referred are the statistical department, where elaborate and extensive Rothamsted data are examined by modern statistical methods, and the work on cultivation which is now being carried out by the physical department and the farm.

University and Educational Intelligence.

DURHAM.—The following honorary degrees were conferred upon members of the British Medical Association on July 21 :—*Doctor of Civil Laws*: Sir William MacEwen, Sir Thomas Oliver, and Sir Humphry D. Rolleston. *Doctor of Hygiene*: Dr. T. E. Hill and Dr. J. W. Smith. *Doctor of Science*: Sir Arthur Keith. *Doctor of Literature*: Sir Dawson Williams, editor of the *British Medical Journal*. *M.A.*: Dr. Alfred Cox, medical secretary of the British Medical Association.

LONDON.—Mr. M. T. M. Ormsby has been appointed as from August 1, 1921, to the Chadwick chair of municipal engineering tenable at University College. Mr. Ormsby was appointed assistant to Prof. Osbert Chadwick at the college in 1898, and since 1914 has been University reader in surveying.

Dr. F. S. Langmead has been appointed as from August 31, 1921, to the University chair of medicine tenable at St. Mary's Hospital Medical School. Dr. Langmead has held a number of posts at St. Mary's Hospital since 1902, also at the Hospital for Sick Children and at the Seamen's Hospital, Greenwich.

The Rogers Prize of 100*l*. for 1921 has been awarded to Mr. Lambert Rogers for an essay entitled "The Surgical Treatment of Hyperthyroidism."

The following doctorates have been conferred :—*D.Sc. in Physics*: Mr. Lewis Simons, an internal student, of King's College, for a thesis entitled "Contributions to the Study of Energy Transformations when X-radiation is absorbed by, or emitted from, a Substance." *D.Sc. (Engineering)*: Mr. K. C. Chakko, an internal student, of University College, for a thesis entitled "Stresses in Chain Links." *D.Sc. in Botany*: Mr. Birbal Sahni, an external student, for a thesis entitled "The Structures and Affinities of *Acomopyle Pancheri*, Pilger." *D.Sc. in Chemistry*: Mr. W. C. Reynolds, an external student, for a thesis entitled "On Interfacial Tension." *D.Sc. in Geology*: Mr. L. F. Spath, an external student, for a thesis entitled "On Cretaceous Cephalopoda from Zululand," and other papers; and Mr. L. D. Stamp, an external student, for two theses entitled "On the Beds at the Base of the Ypresian (London Clay) in the Anglo-Franco-Belgian Basin," and "On Cycles of Sedimentation in the Eocene Strata of the Anglo-Franco-Belgian Basin."

THE Trustees of the Beit Fellowships for Scientific Research, which were founded and endowed in 1913 by Sir Otto Beit in order to promote the advancement of science by means of research, have recently elected to fellowships Messrs. H. L. Riley and W. A. P. Challenor. Mr. Riley was educated at the Keighley Trade and Grammar School, 1910–17, and has been a student at the Imperial College of Science and Technology from 1919 to date. Mr. Challenor was educated at Whitchurch Grammar School, 1911–17, and has been a student at the Birmingham University from 1917 to date. Both will carry out research at the Imperial College of Science and Technology at South Kensington.

IT was announced in NATURE of July 7, p. 604, that Mr. H. H. Wills had presented the University of Bristol with the sum of 200,000*l*. for the provision of a new physics laboratory. Further particulars have now been received. Two gifts totalling 200,000*l*. were received, and the Council of the University has now approved plans and signed a contract for the erection of a building. It is estimated that the work will absorb the whole of the original gifts, together with the interest on the fund, amounting to 21,000*l*., which has since accrued. The Council has further decided to associate the name of Mr. Henry Wills permanently and for all time with the department by naming the building "The Henry Herbert Wills Physical Laboratory." In this Bristol is following the precedent of other universities in associating the name of the donor with a laboratory erected by him for a particular subject. The building, which is Early Renaissance in style, will be a four-floor structure in the shape of the letter "L," to be erected on the north-east side of the Royal Fort Estate. The architects have been most successful in securing both architectural beauty and all the facilities of light and other special requirements demanded by a science department. When it is erected Bristol will possess the best building for teaching and research work in physics in the world. The total amount contributed to the University of Bristol by various members of the Wills family now exceeds 900,000*l*.

SIR MICHAEL SADLER, Vice-Chancellor of the University of Leeds, in the course of an address after opening the new buildings of the Community of the Resurrection at Mirfield on July 16, said that modern civilisation was one of the colossal facts in the world's history. It had been achieved by the courage and labour of Western men during four centuries. Its essence was power. Its phases had been the power of the individual pioneer, the power of the State, the power of the sea, the power of the machine, the power of coal, and the power of high explosives. Through this stupendous outburst of power Providence had permitted a great change in the lives of men and in the outlook of their minds. It had quickened invention; it had flowered in great literature; it had multiplied opportunity; it had created wealth beyond even the dreams of avarice. Of the six most brilliant epochs in human history modern Western civilisation had been one. But now in its heart and conscience there is foreboding. Power, which is the essence of modern civilisation, threatens to destroy it. Three men so typical as Viscount Grey, Mr. H. G. Wells, and the Dean of St. Paul's warn us that modern civilisation is at the cross-roads of its destiny. Unless, by some deflection of its recent purpose, power can be concentrated upon the constructive works of peace, it will destroy civilisation by war. At this moment the Middle Ages seem to whisper once more the message of an ideal which in modern times most men have discarded or have tried, however wistfully, to forget. In industry men begin to think of the medieval guilds. In art the naive sincerity of the primitive painters inspires some of those moderns whose pictures are religious. In politics men speculate as to the possibility of a Council of the Peoples which may recognise nationhood, but allay its rivalries. We cannot go back to the Middle Ages and become medieval in all our thought and way of life. But it is possible that the future may blend some medieval ideas with those derived from the age of power, and that what is perilous in some modern tendencies may be transmuted by a rediscovery of some aspects of truth better known to the medieval than to the modern mind. To the medieval thinker three mysterious powers sustained, by their harmonious working, the life of Christendom. They were called the priesthood, the Empire, and the university: Sacerdotium, Imperium, and Studium. For all three in a form adapted to modern needs the modern world may find a place.

THE recent annual meeting of the council of the Association of University Teachers was held at Bedford College, London, and was well attended by delegates from the various university institutions of England and Wales. The president, Prof. John Strong, of the University of Leeds, in his retiring address indicated the general aims of the association, the lines on which it has been working, the progress made, and some of the more important problems opening up. The primary aims were the advancement of knowledge and the furtherance of the interests of the universities. So long as the universities were in difficulties regarding finance, so long would their work suffer. Such questions as teachers' salaries and superannuation were, under present conditions, insistent. The superannuation question had not been settled by the recent grant from the Treasury, nor was the problem of salaries yet solved, although progress towards a solution was apparent. Apart from these, other and equally serious questions were arising. The relation of the universities to the State and to the local authorities would demand more and more serious consideration. While greater financial support from the Government was imperative, the matter of similar and more uniform support from the local education authorities was urgent. The suggestion of a uniform local rate being levied upon all the local education authorities had much to be said in its favour, but, among other things, it would mean increased local representation. Consideration of these points gave rise to the question of the possible infringement of the present autonomy of the universities—a matter of vital importance to the teaching body. Any such possibilities would have to be watched carefully by the universities. The officers and executive committee for the coming year were elected as follows:—*President:* Prof. John Strong (Leeds). *Vice-Presidents:* Prof. McBain (Bristol) and Mr. F. Boulden (Sheffield). *Treasurer:* Asst. Prof. Tabor (Imperial College). *Hon. General Secretary:* Mr. R. D. Laurie (Aberystwyth). *Executive Committee:* Prof. Calder (Manchester), Prof. Dame Helen Gwynne-Vaughan (Birkbeck College), Mr. Haigh (Reading), Miss Halket (Bedford College), Prof. Lea (Birmingham), Prof. Mair (Liverpool), Mr. Monahan (Leeds), Prof. Orton (Bangor), Asst. Prof. Philpot (University College, London), and Prof. Truscott (Imperial College).

Calendar of Scientific Pioneers.

July 28, 1818. Gaspard Monge, Comte de Péluse, died.—The creator of descriptive geometry, Monge was a prominent figure through the whole of the Revolutionary period. He had a great share in founding the Ecole Polytechnique, and, like Berthollet, was a favourite of Napoleon. At the Restoration he was expelled from the Institute on account of his having voted for the death of Louis XVI.

July 29, 1751. Benjamin Robins died.—A mathematician of distinction, Robins invented the ballistic pendulum and carried out a series of experiments which marks an era in the history of gunnery. He died at Madras as chief engineer to the East India Company.

July 29, 1869. Joseph Beete Jukes died.—A favourite pupil of Sedgwick, Jukes became naturalist to H.M.S. *Fly* in Australia (1842–46), and from 1850 was director of the Geological Survey of Ireland.

July 29, 1885. Henri Milne-Edwards died.—Milne-Edwards filled the chairs of entomology, zoology, and physiology at the Jardin des Plantes, studied the natural history of the coasts of France and Sicily, and wrote valuable works on the Crustacea, on the corals, and on physiology and comparative anatomy.

July 29, 1898. John Alexander Renia Newlands died.—One of the first to indicate that the properties of the elements are related to their atomic weights, Newlands practised in London as an analytical chemist.

July 30, 1832. Jean Antoine Chaptal, Comte de Chanteloup, died.—A member of a wealthy family, Chaptal engaged in practical chemistry, and during the Revolution superintended the manufacture of gunpowder. Under Napoleon he served as Minister of Instruction, and did much to further the industrial arts and manufactures of France.

July 30, 1913. John Milne died.—For twenty years professor of geology and mining at the Imperial College of Engineering, Tokyo, Milne made an exhaustive study of earthquakes. He founded the Seismological Society of Japan, invented various instruments, and contributed numerous papers on seismology to the British Association and other bodies.

July 31, 1839. Gaspard Clair François Marie Riche, Baron de Prony, died.—A famous member of the Corps des Ponts et Chaussées, Prony during the Revolution directed the compilation of extensive logarithmic tables. He became a professor at the Ecole Polytechnique, and was employed on many civil engineering works of importance. The Prony friction dynamometer was his invention.

August 1, 1769. Jean Chappe d'Auteroche died.—An assistant astronomer of the Paris Academy of Sciences, the Abbé Chappe d'Auteroche observed the transit of Venus of 1761 at Tobolsk, Siberia, and that of 1769 at St. Joseph, California, where he died of fever brought on by his exertions in the interest of science.

August 2, 1823. Lazare Nicholas Marguerite Carnot died.—Carnot began life as a military engineer. He helped to found the Ecole Polytechnique, and was one of the first members of the Institut de France. His work of 1803, "Géométrie de position," gives him a place beside Monge and Poncelet as one of the founders of modern geometry, and as a military engineer he is remembered for his great work on fortifications.

August 3, 1770. Guillaume François Rouelle died.—As professor of chemistry in the Jardin du Roi, Rouelle attracted much attention by his lectures and his new ideas. Lavoisier and Proust were among his pupils.

E. C. S.

Societies and Academies.

LONDON.

Faraday Society, June 22.—Prof. A. W. Porter, president, in the chair.—C. J. **Smithells** (for the Research Staff of the General Electric Co.): High-temperature phenomena of tungsten filaments. Part i. Two types of tungsten wire are in general use for lamp filaments. One is composed of pure tungsten, and the other of tungsten containing up to 1 per cent. of a refractory oxide such as thoria. The crystal growth during burning has been investigated for both types. It is shown that the deformation of the filament which occurs during life is a function of the crystal growth. Crystal growth, which is suppressed in thoriated filaments, occurs when the thoria is reduced. Thoria and other refractory oxides can be reduced by phosphorus vapour at a high temperature. Part ii. deals with the chemical reactions which occur in gas-filled tungsten filament lamps when traces of the common gases are present in the filling gas.—E. **Hatschek**: A simple apparatus for determining the coagulation velocity of gold sols. The percentage of blue formed in coagulation of red gold sol is taken as a measure of the degree of coagulation. The percentage is determined by comparing the original red sol with a double wedge, one half consisting of the original sol, and the other of the completely coagulated blue sol. It is necessary that the latter should be coagulated by the same electrolyte as that used in the sol under examination, as the blues obtained with different electrolytes are not exactly alike. A number of determinations have been compared with V. Smoluchowski's formula for the coagulation velocity, and show good agreement for complete and fairly rapid coagulation.—Prof. A. W. **Porter**: The variation of surface tension and surface energy with temperature. Any satisfactory formula must correspond with the vanishing of both the surface tension σ and the surface energy u at the critical point. The connection is $u=\sigma-\mathrm{T}\frac{\partial\sigma}{\partial\mathrm{T}}$; hence $\frac{\partial\sigma}{\partial\mathrm{T}}$ must also vanish at the critical point. These conditions are all satisfied by the formula put forward by van der Waals, and afterwards by Allan Ferguson, viz.

$$\sigma=\text{constant }(\mathrm{T}_c-\mathrm{T})^n,$$

where n is a constant between 1·2 and 1·3. Whittaker has shown that u is proportional to T × internal latent heat. The author shows that if the reduced temperature be taken as the factor (instead of T), the numeric values show that for many substances u and the internal latent heat of evaporation tend to equality (on the C.G.S. system) as the temperature is approached. He also directed attention to the connection between van der Waals's equation for σ and Thiessen's equation for the latent heat, $\sigma=\text{constant }(\mathrm{T}_c-\mathrm{T})^m$, where m is about 0·3.—S. M. **Neale**: The influence of solvent upon ionisation and the accompanying heat effect. A determination by electrical conductivity methods of the ionisation of picric and *para*nitrobenzoic acids in mixtures of acetone and water. From the values obtained at 25° and 35° C. the heats of ionisation are calculated. In the case of picric acid the heat of ionisation varies largely with the nature of the solvent, passing through a minimum at about 70 per cent. acetone. In the case of *para*nitrobenzoic acid the heat of ionisation is sensibly zero both in water and in 44 per cent. acetone, although in the latter solvent the ionisation constant has fallen to 1/20th of its value in pure water as solvent.—A. **McKeown**: The potential of the iodine electrode and the activity of the iodide ion at 25° C. The potential of the saturated iodine electrode in combination with the normal calomel electrode has been measured for various values of the concentration of the iodide ion. The results have been compared with those of other investigators, making use of the concept of activity coefficient; the activities of the iodide and of the tri-iodide ion in the various solutions have been estimated and compared with the values of the concentration of these ions. It is found that the activities of both ions increase less rapidly than their concentrations. From the results the normal potential of the iodine electrode is calculated to be +0·2454 volt, the normal calomel being taken as zero.

PARIS.

Academy of Sciences, July 4.—M. Georges Lemoine in the chair.—The president announced the death through a motor-car accident of Jules Carpentier, free member.—G. **Lemoine**: The mutual reaction of oxalic acid and iodic acid. The influence of different catalysts. As catalysts, platinum sponge, platinum black, wood charcoal, and sugar carbon were used. In general, for the same reaction velocity a higher temperature was necessary in the absence of a catalyst. Increasing the weight of catalyst increased the reaction velocity, but this was proportional neither to the weight nor to the surface. The activity of the platinum black was very great in proportion to the other substances.—A. **de Gramont**: Spectra of quantitative sensibility of silicon in fused salts and in steels. Working with fused salts, two characteristic lines of silicon persist down to a content of 0·005 per cent. of silicon. With steel, the sensibility is less on account of the brightness and number of the iron lines.—P. **Sabatier** and B. **Kubota**: The action of heat on allyl alcohol in presence of various catalysts. There are two main reactions, dehydrogenation and dehydration; copper and manganous oxide especially effect the first of these, and tungstic acid, thoria, and alumina the second. With zirconia and uranic oxide both reactions occur together. Owing to secondary changes the final product is very complex, and contains water, acrolein, propyl aldehyde, higher aldehydes formed by condensation, and hydrocarbons (mesitylene). The gases include propylene, hydrogen, carbon monoxide, and dioxide, but neither acetylene, allene, nor allylene could be detected.—B. **Gambier**: Imaginary surfaces applicable to a surface of revolution; real corresponding cyclic systems.—D. **Riabouchinski**: The cyclic movement of a liquid round a solid which moves parallel to a rectilinear wall.—J. **Mascart**: Observation of the occultation of Venus of July 1, 1921, made at the Observatory of Lyons. Observations were made under good atmospheric conditions by six observers with different types of instrument.—E. **Belot**: The law of rotation of the sun explained by evolution and flattening of the protosun.—M. **Brillouin**: Bohr's atom. The circumnuclear Lagrange function.—A. **Lafay**: The figures of M. de Heen and the electric discharge.—M. **Solomon**: A radiological ionometric arrangement. A description of an apparatus for the measurement of ionisation in medical radiology. It is standardised by a known quantity of radium.—A. **Dauvillier**: The principle of combination and the absorption lines in the X-ray spectra.—A. **Marcelin**: Surface tension of the monomolecular layers.—A. de G. **Rocasolano**: Variations of catalytic power in the electroplatinosols.—G. **Tanret**: An ammonium molybdo-quinate. Quinic acid is known to show a marked increase in rotatory power when mixed with solutions of molybdates. This is due to the formation of a definite complex compound, ammonium molybdo-quinate, the isolation and analysis of which are described.—J. **Cvijić**: The correspondence of the fluvial steps and river-banks.—R. **Souèges**: The embryogeny of the Labiates. Development of the embryo in *Glechoma hederacea* and in *Lamium purpureum*.—P. E. **Pinoy**: The germination of the spores, the nutrition, and the sexuality of the Myxomycetes.—Mme. Z. **Gruzewska**: The mucilaginous substances of *Laminaria flexicaulis*. Nitrogen does not appear to be an essential constituent of the mucilage; hydrolysis is slow, the sugar formed being glucose or galactose.—G. **Bertrand** and R. **Vladesco**: The variation in the proportion of zinc in the organism of the rabbit during growth. The proportion of zinc contained in the entire body of the rabbit is a maximum at birth, diminishes during the period of lactation, and then, after the twenty-fifth day, on weaning, the zinc increases rapidly.—H. **Bierry**, F. **Rathery**, and Mlle. **Levina**: The proteid sugar in cancerous subjects. The amounts of free sugar and proteid sugar in the blood-plasma of ten cancerous subjects have been determined. The proteid sugar is from twice to four times the normal amount.—M. **Aron**: The existence and *rôle* of an endocrinian tissue in the testicle of some Batrachians.—C. **Pérez**: A new Ceponian, *Onychocepon harpax*, a branchial parasite of Pinnotheres.—H. **Faes** and M. **Staehelin**: The resistance of the adult cockchafer to low and high temperatures. The adult cockchafer can be submitted to a temperature down to -8° C. and recover its activity on warming; at lower temperatures it is killed. This insect is more susceptible to high temperatures, since at 45° C. it is killed.

BRUSSELS.

Royal Academy of Belgium, January 8.—M. A. Gravis in the chair.—A. **Demoulin**: The equations of Moutard with quadratic solutions.

February 5.—M. G. Cesàro, president, in the chair.—C. **Julin**: Report of the decisions taken at the meeting of the section of biological oceanography of the International Union of the Biological Sciences.—J. **Massart**: The four steps of sexual conjugation.—P. **Stroobant**: Complementary note on the nature of the temporary stars.—C. **Servais**: A group of three tetrahedra.—P. **Nolf**: The action of chloroform on the coagulation of the blood plasma of birds. Antithrombosine is generally considered the physiological antagonist of thrombine, its function being to neutralise this substance wherever it is in excess. This is not found to be in accord with the experiments described. It would appear that antithrombosine, instead of neutralising thrombine, contributes to its formation.—Th. **de Donder**: The *gravific* field.—L. **Godeaux**: Researches on the cubic involutions belonging to an algebraic surface.—F. **Carpentier**: The prothoracic endo-skeleton of *Gryllotalpa vulgaris*.

March 5.—M. G. Cesàro, president, in the chair.—A. **de Hemptinne**: The law of Faraday, and the action of the silent electric discharge on the metallic oxides. An account of experiments in which the oxides of lead, copper, nickel, and mercury are exposed to the silent discharge in an atmosphere of hydrogen under reduced pressures (10 to 30 mm.).—E. **van Aubel**: (1) The atomic heat of the elements. According to a recent communication by M. Félix Michaud, the atomic heat should have the value 3·5 for a temperature corresponding to a maximum of the quotient CA/T (where C is the specific heat, A the atomic mass, and T the absolute temperature). An examination of the values for silicon, boron, rhombic sulphur, thallium, magnesium, and chromium shows that these substances are not in accordance with M. Michaud's rule. (2) The density and refractive index of mixtures of aldehyde with water or ethyl alcohol.—C. **Servais**: Quadrics of revolution conjugated to a tetrahedron.—E. **Henriot**: The variation of the refractive index of liquids with density.

April 9.—M. G. Cesàro, president, in the chair.—G. **Cesàro**: Some new forms of orpiment from Balia, Asia Minor.—C. **Servais**: A curve of the third order associated with a triangle.—P. **Stroobant**: Observation of a shooting star at Brussels.

May 3.—M. G. Cesàro, president, in the chair.—M. **Stuyvaert**: An element analogous with a curvature at a point external to a plane algebraic curve.—L. **Godeaux**: Some linear congruences of skew cubics considered by M. Stuyvaert.—P. **Bruylants**: The action of the organo-magnesium compounds on glutaric nitrile. This nitrile behaves as a pseudo-acid, and on acidifying the reaction product nearly the whole of the nitrile is recovered. There is a secondary reaction producing a very small quantity of a ketone, probably $C_2H_5.CO.(CH_2)_3.CN$.—H. **Vanderlinden**: The *gravific* field of an electrified sphere.

ROME.

Reale Accademia nazionale dei Lincei, May 8.—F. D'Ovidio, president, in the chair.—Papers by fellows:—C. **Somigliana**: Depth of glaciers, i. The equations of motion are found for a glacier, and are identical in form with those of a viscous liquid moving slowly in a tube inclined to the horizon. This very natural conclusion is justified by the property that the velocity of the glacier is considerably less than the critical velocity at which fluid motion becomes turbulent. It might be suggested, however, to Prof. Somigliana that the cracking of the ice substitutes another effect limiting the applicability of the equations in this case.—F. **Severi**: Integrals of first species, v.—O. M. **Corbino**: Thermal analogue of Oersted-Ampère effect, ii.—Papers communicated through a fellow:—G. **Abetti**: Astronomical determinations of latitudes and longitudes in Central Asia. These were carried out in De Filippi's expedition in 1913–14 by the author and Comdr. A. Alessio, the longitudes being referred to the meridian of the transit circle of Dehra Dun by wireless signals from the Trigonometrical Survey of India. The observations were made at the following stations: In Baltistan at Tolti, Wazul Hadur, Scardu, and Càrghil; in Ladak at Lamairu and Leh; in Caracorùm at Depsang and the front of the Rimu glacier (altitude 4912 metres); and in Turkestan at Sughèt Carol, Jàrcand, and Càshgar.—C. **Perrier**: Presence of zinc in the malachite of Chessy. A comparison of malachite and the new mineral rosasite is given.—C. **Gorini**: Proteolitic activity of lactic ferments, v. Phenomena of rapid physiological mutation.—D. **Maestrini**: Enzymes, vi. Protective power of starches and other substances on phthalin in acid media.—J. **Pérès**: "Transformations qui conservent la composition." A sequel to the author's previous contributions in the *Annales de l'Ecole normale supérieure* and *Bulletin de la Société mathématique de France*, published in 1919.

SYDNEY.

Royal Society of New South Wales, June 1.—Mr. E. C. Andrews, president, in the chair.—A. R. **Penfold**: The occurrence of a new phenol in the essential oils of the Leptospermum. In the course of the examination of the essential oils obtained from *Leptospermum flavescens* growing in various parts of New South Wales, a phenolic body was found to occur in amounts varying from 0·75 to 8 per cent., the latter being obtained from material growing in the Lane Cove (Sydney) district. It has been named "Leptospermol."

Books Received.

Sitzungsberichte der Königl. Bohmischen Gesellschaft der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe. Jahrgang 1915, 1916, 1917. (Prag: Fr. Řivnáč.)

Mémoires de la Société Royale des Sciences de Bohême. Classe des Sciences. Année 1918: Année 1919. (Prag: Fr. Řivnáč.)

Ladislav Pračka. Untersuchungen über den Lichtwechsel Älterer Veränderlicher Sterne. By Prof. Dr. Vojtěch Šafařik. Vol. ii. Sterne des A.G. Kataloges von $5^h\ 21^m$ bis 24^h A.R. Pp. iii+180. (Prag: Fr. Řivnáč.)

North England: An Economic Geography. By L. Rodwell Jones. Pp. viii+256. (London: G. Routledge and Sons, Ltd.) 6*s*. net.

Textile Design and Colour: Elementary Weaves and Figured Fabrics. By W. Watson. Second edition. Pp. xi+436. (London: Longmans, Green and Co.) 21*s*. net.

Ministry of the Interior, Egypt: Department of Public Health. Reports and Notes of the Public Health Laboratories, Cairo: No. 4. Nutritive Value and Characters of Rations Issued to Officials and Others in Different Administrations of the Egyptian Government. Pp. v+57. (Cairo: Government Publications Office.) P.T.20.

The Statesman's Year-Book, 1921. Edited by Sir J. Scott Keltie and Dr. M. Epstein. Fifty-eighth annual publication. Pp. xliv+1544. (London: Macmillan and Co., Ltd.) 20*s*. net.

The Joy of Mountains. By William Platt. Pp. 80. (London: G. Bell and Sons, Ltd.) 1*s*. 9*d*.

Fundamental Principles of Organic Chemistry. By Prof. Charles Moureu. Authorised translation from the sixth French edition by W. T. K. Braunholtz. Pp. xviii+399. (London: G. Bell and Sons, Ltd.) 12*s*. 6*d*. net.

The Flora of the Nilgiri and Pulney Hill-Tops. By Prof. P. F. Fyson. Vol. iii. Pp. xviii+581. (Madras: Government Press.) 15.6 rupees.

Forestry Commission. First Annual Report of the Forestry Commissioners: Year ending September 30, 1920. Pp. 60. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry: Meteorological Office. British Meteorological and Magnetic Year Book, 1910. Part vi.: Réseau Mondial, 1910. Charts showing the Deviation of the Pressure and Temperature from Normal Values for each Month and for the Year. (London: H.M. Stationery Office.) 8*s*. 6*d*. net.

Camping and Woodcraft: A Handbook for Vacation Campers and for Travelers in the Wilderness. By H. Kephart. New edition (two volumes in one). Pp. 405+479. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 16*s*. net.

The Electric Furnace. By Dr. J. N. Pring. (Monographs on Industrial Chemistry.) Pp. xii+485+xix. (London: Longmans, Green and Co.) 32*s*. net.

Principles of Radio-Communication. By Prof. J. H. Morecraft. Pp. x+935. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 45*s*. net.

The Silviculture of Indian Trees. By Prof. R. S. Troup. Vol. i.: Dilleniaceæ to Leguminosæ (Papilionaceæ). Pp. lviii+336+iii. Vol. ii.: Leguminosæ (Cæsalpinieæ) to Verbenaceæ. Pp. xi+337–783+iv. Vol. iii.: Lauraceæ to Coniferæ. Pp. xii+785–1195. (Oxford: Clarendon Press.) 3 vols., 5*l*. 5*s*. net.

The Development of the Atomic Theory. By A. N. Meldrum. Pp. ii+13. (London: Oxford University Press.) 1*s*. 6*d*. net.

Brown Bast: An Investigation into its Causes and Methods of Treatment. By A. R. Sanderson and H. Sutcliffe. Pp. 71+26 plates. (London: Rubber Growers' Association, Inc.) 7*s*. 6*d*. net.

Growth in Trees. By W. T. MacDougal. Pp. 41. (Washington: Carnegie Institution.)

The Microtomist's Vade-Mecum: A Handbook of the Methods of Microscopic Anatomy. By A. B. Lees. Eighth edition, edited by Dr. J. B. Gatenby. Pp. x+594. (London: J. and A. Churchill.) 28*s*. net.

A Practical Handbook of British Birds. Part xi. Pp. 177–256. (London: H. F. and G. Witherby.) 4*s*. 6*d*. net.

Berichte der Naturforschenden Gesellschaft zu Freiburg i Br. Dreiundzwanzigster Band, Erstes Heft: Erschienen zur Feier des 100 Jährigen Bestehens der Gesellschaft. (Freiburg i Br.: Speyer und Kaerner.)

Insect Pests of Farm, Garden, and Orchard. By E. Dwight Sanderson. Second edition, revised and enlarged by Prof. L. M. Peairs. Pp. vi+707. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 26*s*. net.

ERRATUM.—The publishers of G. Spiller's "A New System of Scientific Procedure," included in last week's list, are Messrs. Watts and Co., and not Messrs. Chatto and Windus as stated.

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