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Education and Industry.

"INTELLECTUAL forces are . . . broken and unco-ordinated. Stores of rich material and reservoirs of valuable experiences have been accumulated in national and local collections, and in the professional and other scientific and commercial associations. But the channels of communication . . . are scanty. . . . Each of some 140 local education authorities provides technical education suitable to its own local needs and limited by a generous or a parsimonious financial policy. Is the total effect a patchwork or an organic whole? Wasteful or efficient? . . . how can industrial organisations . . . and local industrial experience be brought into closer co-operation with those who provide the funds and control the schools and colleges? . . . Finally, there is left the question of which Central Authority is to direct the operations of the intellectual forces. . . . Some half-dozen government departments are engaged, directly or indirectly, in the application of education and research to industrial (including agricultural) problems. But there does not appear to be any minister in any department whose duty it is to see that these departmental efforts are duly co-ordinated."

These extracts from a recently published Report [1] give some indication of the problems which faced the committee responsible for its compilation. The Report falls into three main divisions. The first, from which we have already quoted, briefly summarises the history of the wide problem of education and industry. Inevitably it recapitulates the arguments and conclusions to which other bodies, dealing with similar tasks, have been forced; arguments which are so simple that it is a matter for astonishment that they should fail to be grasped and applied. Their base has been outlined in these columns over and over again when we have urged a revision of traditional educational philosophy. It is that within a relatively brief period we have passed from a non-scientific to a scientific age. The face of industry has changed: its conditions have radically altered; and these conditions and changes have had their reflection in the ordinary national life. "Life itself has been extended," says the Report. "The engineer, the chemist, and the medical officer have broadened the basis, protected our food supply, and safeguarded the public health. The statistician and the press register daily records of the temperature, the pulse, and the blood-pressure of national existence. Science has given us a new era."

The second division assumes a particularly high value. It is a report collated by the Federation of British Industries, and may therefore be regarded

[1] Report of an Inquiry into the Relationship of Technical Education to other Forms of Education and to Industry and Commerce. Pp. 50. (A.T.T.I. Offices, 29 Gordon Square, London.) 1s.

as the industrial view of the Committee's problems. Too frequently, when efforts have been made to bridge the gap between education and industry, has the charge been made that it is the prejudiced voice of the educationist which speaks, and not the voice of those daily in practical touch with industrial and commercial activities. This division of the Report to which we now refer is, we understand, solely the work of the F.B.I., and is the result of "replies of a number of Associations and also individual opinions of manufacturers in all trades throughout the country." At least in one respect it ought to destroy the notion, still cherished in some academic circles, that industry refuses to recognise its own weaknesses, and shelters them behind loud criticism of the educational system. For, although it does not fail to criticise "the incomplete nature of elementary education" and asks for closer consideration to the question of securing suitable teachers in technical institutions (here, indeed, another popular charge against industry is upset, for "it is suggested that the emoluments are in some cases not sufficient to attract those best equipped for the training of our technical school students"), it states quite frankly that a complete expression of industrial opinion is difficult to obtain, since, "generally speaking, there has been no formulated policy regarding technical education, and in many trades it has not even been considered."

Clearly, it is difficult for busy manufacturers to prepare detailed educational schemes for their individual business, and the very sensible suggestion is therefore made that a memorandum should be prepared "covering the main features desired in any technical training. This memorandum, being of a national character, could then be expanded by trades in consultation with the technical authorities into comprehensive courses." Although industry may regard itself as unable to give a complete solution to the educational problems it desires to have solved, there are two outstanding points in its contribution to the Report. First, in reply to the direct question, "Do you regard technical education as essential to the conduct and development of your industry?" the replies showed "an overwhelming body of opinion as to not only the desirability, but the absolute necessity of an adequate technical education." Then comes the suggestion, which shows clearly that no mere vocational training in separate processes is confused with the term 'technical education': to be complete, it "must envisage not only the technique of production, but also the selling and distribution and the interlocking of these three aspects with costing and other statistics leading to management and administration."

The third division of the Report consists of summaries of the answers received in reply to special *questionnaires* sent to local education authorities, technical institutions, and schools of art in England and Wales. Since these summaries embody the results of thirty-eight searching questions, space precludes any attempt to deal with them at length. It is to be noted, however, that the difficulty of recruiting staffs composed either of teachers experienced in industry who understand the art of teaching, or experienced teachers with a wide knowledge of industry, presents a special problem.

While advisory committees are the usual means of linking schools and industries, employers serve on many governing bodies, but employees (as such) rarely do so. This question of a stronger link was further emphasised when information was sought as to whether technical education should be organised by local education authority areas or by industrial areas (*e.g.* cotton, heavy chemical trades, coal mining, printing, etc.). The replies included such suggestions as (*a*) a joint board of local education authorities and representatives of industry (over industrial areas); (*b*) the centralising of teaching at new faculties of modern universities; (*c*) advisory committees; (*d*) central colleges for advanced courses (costs to be apportioned over the area served); and (*e*) inter-county arrangements. Obviously, however, the value of technical colleges as places of research is of vast importance in the further co-ordination of education and industry, and here the Report expresses astonishment at the rarity of any relationship with research institutes. There are, of course, outstanding examples, such as the close relationship at Manchester and Bolton with the British Cotton Industry Research Association; at Bradford and Nottingham with the British Research Association for the Woollen and Worsted Industries; and at Loughborough with the Iron and Steel Institute.

Much remains to be done, however, in this direction. Outside consulting work done by colleges helps to some extent, but that there does not appear to be any general method of its organisation, and that it is subject to varying conditions and regulations in different places, is shown by the dissimilar arrangements for the allocation of fees charged to authority and teacher. But the main obstacle to research appears to lie in the conditions of the Teachers' Superannuation Acts. "The

London County Council suggests that the reaction on both staff and students, of actual contact with works problems, is of considerable importance; that the arrangements in force regarding superannuation . . . makes official recognition of research impossible." The importance of this matter is shown strikingly by the fact that, prior to present regulations, this authority had in view the adoption of a rule making the carrying out of some research work by individuals a condition of employment. Not only in London is research appreciated. A "considerable amount is conducted" at Loughborough, and the "governors are anxious to develop" it; in Leicester it is strongly "encouraged"; "every facility" is afforded in Nottingham (University College); at Bristol (Merchant Venturers) it is "encouraged in all departments"; Bradford provides "ample facilities and every encouragement"; Hull Education Authority is "considering relieving staff from teaching duties to undertake research."

In spite of the valuable information which is presented by the Report, however, it is, at first sight, disappointing in that it puts forward no definite conclusions. Certainly, in a brief paragraph the essentially liberal qualities of technical education are emphasised, but no attempt seems to have been made to sketch out the kind of new educational philosophy which must, in view of our changing and complex modern life, take the place of the older traditions. Present relationships between technical schools, secondary schools, and universities are shown rather by implication than by definite clear-cut statement, and there appears to be no suggestion as to what should be the next step. After collecting such valuable evidence, the Committee seems content to submit "that the facts set out in this Report and in the documents which accompany it, justify its appeal for taking stock of the present condition of technical education, its relationship to general education, and, above all, of the obstacles to closer co-operation with industry."

We presume that this appeal is made to the Board of Education, and we are, of course, aware that already an influential deputation, led by Lord Gainford, and consisting of representatives of education, employers, and trade unions, has already presented the Report to the President of the Board, who has promised to see the Committee again after he has read it. But if the next move lies with the President, it becomes difficult to reconcile that with industry's view that "it would appear to be of very doubtful value to press for any further Government activity in the immediate future until efforts have been made to establish the closer relationship" of technical education and industry. Clearly, the Committee has itself established unique machinery; for we do not remember when, in the educational and industrial history of Great Britain, so many powerful bodies were drawn together to attempt the solution of this imperative question. We would therefore have expected that some suggestion might have been made as to how this present machinery might have been used to reach the ends desired.

When, however, we consider the history of this movement to link education and industry, we realise that the Committee may have done wisely in avoiding the temptation to map out definite schemes. The problem is so wide and far-reaching, and already some aspects of it have been discussed by the Hadow, Malcolm, and Balfour Reports. We recall, too, that when the present Committee submitted its purpose to the President of the Board of Education more than two years ago, the latter hinted that until he had before him the findings of all the committees concerned he would not be able to give any pronouncement concerning the steps which ought to be taken to accomplish the end all of them had in mind. The Hadow and the Malcolm Committees have already presented certain definite proposals. The Balfour Committee, like the present Committee, hesitated, in the first part of its industrial survey of "Factors in Industrial and Commercial Efficiency" (see NATURE, April 9, 1927, p. 517 *et seq.*), to make any definite recommendations. Its aim was rather to assemble and analyse facts and tendencies and so to prepare the way for further intelligent study of issues which are so supremely important to national well-being. Definite recommendations from various committees are apt to be mutually cancelling.

Still, there are now four reports available for the President of the Board of Education (our own comments on the Hadow Committee appeared in NATURE of Feb. 5, 1927), and we shall await with some anxiety any official pronouncement of their effect upon future progress.

In the meantime we congratulate the Committee responsible for the Report before us, not only on the collection of its invaluable evidence, but also upon its own unique constitution. We would emphasise that that constitution includes, in addition to all types of teaching bodies and learned and professional organisations, the Federation of British Industries and the General Federation of Trade Unions. Surely here is machinery which must not be allowed to cease functioning.

The Nature of Solutions.

The Scientific Work of the late Spencer Pickering, F.R.S. By Prof. T. M. Lowry and Sir John Russell. With a Biographical Notice by Prof. A. Harden. Pp. ix+247. (London: Harrison and Sons, Ltd., 1927.) 4*s*.

THE origin of this work is the following clause in the will of the late Mr. Pickering, who died in December 1920:

"I give to the Treasurer of the Royal Society of London, Burlington House, Piccadilly, free of duty, the sum of £1000 upon trust to procure the writing and publication in book form of an account of my work in pure science or of such part of it as may seem suitable for such treatment."

Spencer Umfreville Pickering, to use words written of Fleeming Jenkin, by R. L. Stevenson, was "a man much more remarkable than the mere bulk or merit of his work approves him." An aristocrat by birth and breeding, in appearance and manner, of very determined individuality, he was yet one of the gentlest and most sympathetic natures possible in face of the few whom he knew towards whom he was drawn. No cold recital, such as that before us, of his feats with thermometers—which were stupendous, both the thermometers and the feats—and in disputing the discontinuities in curves with the ungodly or of his freakish treatment of fruit trees can give the faintest picture of the man, of the artistry in his composition and the rare nobility of his character. You saw and felt ancestry in him. To understand him, the family history must be studied—in the autobiography which he lovingly edited, written by his mother, also but incidentally in the works of his younger sister, Mrs. W. A. Stirling, especially in "William de Morgan and his Wife" (Thornton Butterworth, Ltd., London, 1922), in part the life of their elder sister, Evelyn, an appreciated painter of most beautiful decorative pictures in the manner of the Burne Jones school, who married (1887) William de Morgan, the noted potter and novelist, son of Augustus de Morgan, professor of mathematics in University College, London. Pickering, therefore, in middle life, was associated with a highly original artistic circle; he was himself an accomplished musician and a lover of art and literature.

"Of the intellectual qualifications of the Pickerings as a race," Mrs. Stirling remarks, "it is possible to speak with an unusual degree of certainty from a remote period." "I apprehend," said Sir Isaac Heard, Garter King of Arms, writing to their grandfather, "that there is scarcely any family in England so well descended as yours and who can so well authenticate it, not merely by the pedigree but by the records of the kingdom, combining ancient nobility and royalty."

Pickering's father was a Q.C., Recorder of Pontefract, Attorney-General for the County Palatine and sometime Treasurer of the Inner Temple. At Eton, he was known by his long hair and his good looks were proverbial. He became a great friend of young William Ewart Gladstone, who for many years afterwards kept up a correspondence with him in which he expressed himself enthusiastically Tory in principle; only his change in politics, later in life, made a severance between the friends. At the Bar he was noted for his eloquence, his penetration and his sense of humour. When past forty, he married the daughter of Lady Elizabeth Spencer Stanhope. Mrs. Pickering, on her father's side, came of two families—the Spencers and the Stanhopes—who had been settled in Yorkshire since the Middle Ages—a race of fine old country squires. The story of the family has been told by Mrs. Stirling in "Coke of Norfolk and his Friends." Lady Elizabeth was a direct descendant of Thomas, Earl of Leicester, the great dilettante of the mid-eighteenth century. Thomas Coke, who on a barren part of the Norfolk coast erected a palace of Italian art and filled it with choice treasures of antiquity, was the possessor of a master mind and left the impress of genius on all with whom he dealt. His nephew and successor, the father of Lady Elizabeth, better known as 'Coke of Norfolk,' although his best energies were concentrated on agriculture and questions of practical utility, exhibited gifts which equalled those of his predecessors.

Mrs. Pickering, we are told, was a woman of exceptional intellect, whose cleverness lay in deep thought and extensive study. She early devoted herself to the development of her children's minds. Recognising how much she had suffered from the narrowing influence of governesses, at her instance, masters came and went to the house, the most efficient that money could procure. From the first, brother and sister (Pickering was three years Evelyn's junior) profited by the same instruction—learning Greek and Latin, besides French, German and Italian, classical literature and mythology, the mother inspiring in them actual love of knowledge as distinct from the drudgery of lessons. Mrs. Stirling's description of her method is most fascinating:

"In all her children, a recollection of their early years was connected with what proved to them the happiest period of each day, the hour when they

were summoned to a flower-laden room and their mother read aloud to them from some volume of absorbing interest. To her, reading aloud was a gift; she delighted in it; and her clear, musical voice ever after seemed indissolubly linked with the books which she first made them love. The range of literature thus covered was wide and comprehensive; but where the books which were available on any particular subject did not convey the exact impression she wished to produce, she herself supplied the deficiency. Thus history, she found, was apt to be written in a fashion which failed to grip the imagination of a child, so she wrote a history of England for her children of arresting interest, dwelling on the vital facts to be remembered and making the whole so graphic that it became to her small listeners a living actuality teeming with romance. Scientific books, too, she found were inevitably couched in language ill-adapted to the intelligence of her audience, so she wrote for them volumes which read like a fairy-tale: she described the wonderful prehistoric world, where Man was not but where strange beasts abounded and the dim antediluvian forests which æons of time had fashioned into coal, pieces of which were then burning in the grate of the cosy little room; she dwelt on the discoveries of astronomy, the grand riddle of the stars which looked like glittering dust strewn over the dome of heaven; the marvels of chemistry, of geology, of the practical application of many recent discoveries. She wrote fluently, without effort and with few erasures; indeed, the charm and the facility of her style hint what success in the literary world would have been hers had she not confined her talents solely to this labour of love."

What a lesson in method for mothers and teachers generally!

Pickering in his nursery days was a child who arrested attention by his beauty; his hair of bright gold fell in a luxuriant mass of long curls. Even when these were shorn later on, curls still clustered thickly over his shapely head, so that at Eton, on account of his good looks and classical features, he was known as the young Antinous. The picture given as a frontispiece to the volume, though a likeness, in no way does him justice. He entered Balliol College, Oxford, in January 1877, where he remained until the Lent term 1880. Even as a schoolboy he was devoted to chemistry and had his laboratory in the home of the family in Bryanston Square, where all his original work was done up to 1902. Several of his papers had been published in the *Journal of the Chemical Society* before he left Oxford. His chemical precocity is clearly apparent in all of these, especially in the study of the interaction of copper and sulphuric acid and of the loss of sulphur by cupric sulphide.

I learnt to know Pickering at the time of his first appearance at the Chemical Society, of which I was a secretary. We became fast friends and I was witness of and almost a partner in all his attempts to force his work and views on 'The Nature of Solutions' into notice. In this he was both determined and uncompromising—he was so sure of his work and so entirely obsessed by honesty of scientific purpose.

We are carried back to the days when the study of the properties of solutions was beginning to attract the attention of workers generally—to the summer of 1887, when the great Russian chemist, Mendeléeff, visited Great Britain and captured us all by his picturesque appearance and charm of manner. Mendeléeff was present at the British Association meeting in Manchester in 1887. He there gave an account of his views on solutions in a short paper on "The Compounds of Ethyl Alcohol with Water," in which he showed that the curve representing the change in density of solutions of alcohol in water as the concentration was varied could be resolved into several linear terms by plotting the first differential coefficient ds/dp against p. He regarded the points of intersection as *loci* of hydrates. I at once secured the paper from him for the Chemical Society and it appeared in the October number of the *Journal*. Not only so. I induced my pupil Holland Crompton, an able mathematician, to apply the method to Kohlrausch's most striking curve showing the variation in electrical conductivity of solutions of sulphuric acid and to other electrolytes. His paper was read at the December meeting of the Society and after it in the *Journal* was printed a "Note on Electrolytic Conduction and on Evidence of a Change in the Constitution of Water," in which I summarised my views on electrolytic conductivity.

Crompton found that the Kohlrausch curve was resolved only at the second differentiation. I therefore claim, following Mendeléeff, to have started the curve-hunt. Pickering at once joined in and became an enthusiastic user of the method. Having been engaged in studying the thermal behaviour of salts towards water and thereby led to the discovery of breaks which he had supposed to be due to changes in the state of hydration, he was in a highly receptive state of mind and henceforth devoted himself to intensive study of the subject. He made an extraordinarily careful and probably unsurpassable examination, particularly of the densities, of solutions of sulphuric acid and developed a method of analysing his curves with the aid of a bent lath. He came to the conclusion that the curve could be split up into a great number of intersecting elements and urged that the points

of intersection—no less than seventeen in sulphuric solutions—were indications of the formation of distinct hydrates.

There was universal disbelief in the validity of Pickering's conclusions and particularly of the method he used. Rücker, the physicist, was strongly opposed to it. When I consulted my mathematical colleague, Henrici, the authority on graphics, at the time, he gave the opinion that, if the results could be shown by independent methods to be valid, no objection could be taken to the method. Otherwise, it was not possible to pronounce for or against it. Pickering had to fight his way to publication through the by no means encouraging reports of referees chosen from outside the chemical circle and therefore credited with superior authority—but coldly aloof from chemistry, if not unsympathetic. "You can't go outside the opinion of a man like Rücker, you know," was the kind of argument used by objectors. The work was so obviously good, however, so exact and thorough, that he could not well be denied: still, the treatment he received soured his proud nature; he felt he was not being helped, that no sympathy was accorded him. Moreover, he was up against the great wave of fashion which soon set in through Ostwald's persistent advocacy of Arrhenius. No one was prepared to reason.

A so-called discussion took place at Leeds, at the British Association meeting in 1890, which, at the time, struck me as being singularly hollow, lacking both in breadth and logic. Ostwald's contentions were chemically absurd. I notice that, at the recent meeting, the president of Section B referred to Pickering and me as having been 'diehards' at the time. Seeing that we had so recently unfurled our banners, which were quite distinct—I was never an advocate of a mere hydrate theory, at least in Pickering's sense—and that Arrhenius's speculation was also of recent birth, in its accepted form younger than ours, we should have been 'die-easy's' had we lowered our flags at Teutonic challenge, seeing how entirely our antagonists avoided the chemical issue—and have so done to the present day. As Bancroft recently admitted, the function of water in solutions still has to be considered and properly evaluated. Although, forty years ago, I could picture it as having a constitution, it is still worshipped, in all the text-books, as Aitch-too-oh!

It is not difficult to understand that Pickering should have been anxious to have judgment delivered upon his work after his death. The question is—to what extent is the attempt made to do him justice satisfactory? In my opinion it is neither adequate nor properly judicial but lacks both the breadth and critical acumen the subject demanded. Pickering, I am sure, intended and desired that the situation in general should be considered—not merely the validity of *his* work and arguments. His joy was in exact work and his desire: to establish truth.

Pickering directed in his will that *an account* of his work in *pure science* should be procured and published in book form. Instead, we have two accounts, one of his experiments at Woburn on fruit farming, which certainly was not work in *pure science*. This occupies fully one-third of the book. It is written by Sir John Russell with his accustomed skill and ability to summarise an agricultural situation. Sir John makes clear the departure Pickering made from the practice of fruit-growers, the main results of his trials and observations, the new issues raised—in a very interesting manner. We may thank him for the summary.

What Pickering had in mind and desired, I feel sure, was an extensive monograph on "The Nature of Solutions," in which proportionate notice was taken of his work and its bearings. Instead, we have a mere appreciation of the work he did and of his method of interpreting curves, together with an account of his chemical work in general in the form of brief abstracts which read as though they were prepared for the Chemical Society. A wrong note is struck, in the introduction, in the statement, "For the purpose of preparing this memoir, I have received two bound volumes of 'Scientific Papers,' etc." It was the reporter's duty to consider not merely what was put into his hands but the subject at large. Pickering asked for something much broader than a mere consideration of his scientific papers: he would not have assigned £1000 for this purpose. He was a gentleman and never sought the limelight—nor was it ever flashed upon him, so little able were we to appreciate the character of his labours and the example he gave. Even the Chemical Society took no notice of him. In science, as elsewhere to-day, the sensational counts; the value of prolonged exact inquiry is seldom recognised.

Prof. Lowry was peculiarly fitted to appraise the value of Pickering's physical studies of solutions on the practical side, as he is a most accomplished worker himself in the physical field. He does justice to his subject in this respect and finally gives *his opinion*, that Pickering was justified in his conclusions that solutions exhibit a multitude

of discontinuities but takes the view, common among us at the time the work was under discussion, that these are not to be taken each as evidence of a distinct hydrate.

Prof. Lowry leaves the great problem of the nature of solutions undiscussed—makes no attempt, in fact, to bring under notice the vast amount of work done during the past fifty years. He has nothing to say of the solvent—of water itself. He shows that he has neither imagination nor a free mind, no sense of logic. He is willing to accept any freakish new view as it comes along, such as the chess-board conclusion: that there is no bond of union between the constituents of common salt. He declares himself a syncretist by the confession (p. 32), that early in his career "he was faced with the necessity of finding for his own use a scheme which should be compatible with the two rival points of view [dissociation and hydration]. This he found in the idea that *both* views were correct, that their incompatibility was imaginary and not real, and that the hydration of the ions not only provided a way of reconciling the two theories of solution, but also supplied a motive for the electrolytic dissociation of a salt."

The fact is, *pace* Arrhenius, Ostwald and Co., we know nothing of the processes at work in solutions—it was for this reason that Pickering wished to have the subject fully discussed. We need to have all the *facts* assembled and contrasted: then perhaps we shall see a way through the maze. Actually, the facts never are considered but instead various fancy sums are worked on paper and chemical considerations are left out of account, probably physical as well. As Lodge put it in 1889, "chemists have permitted themselves to be run away with by a smattering of quasi-mathematics and an overpressing of empirical formulæ."

The physical chemist has been neither chemist nor physicist at heart. The late Prof. Bateson, I believe, always advocated the view that the production of a 'mutation' involved the loss of a factor: the mutation from chemist to physical-chemist certainly seems to have involved the loss of the primary factor in chemistry: chemical feeling. We have to recover this or chemistry will be imperilled. At least, we should be honest, consider *cons* as well as *pros*, not merely formulate conclusions without any semblance of logic behind them. It was this dogmatic tendency that my friend Pickering always strove to combat. A true analysis of his efforts has yet to be given.

Himself he fell a victim to the modern disease, physical measurement — unavoidable, doubtless, like measles, yet like this disease often followed by severe after-effects, especially loss of the imaginative faculty. He became so much the slave of sub-minute precaution, that chemical artistry went out of him. He so lived the life of the recluse, in his aristocratic contempt of the Little-enders, that we never recovered him to that broader service in chemistry of which he showed himself capable particularly in his first essay and in his devotion to the fruit of the soil.

HENRY E. ARMSTRONG.

Isaac Newton.

Isaac Newton, 1642–1727. A Memorial Volume edited for the Mathematical Association by W. J. Greenstreet. Pp. vii + 181 + 9 plates. (London: G. Bell and Sons, Ltd., 1927.) 10*s.* 6*d.* net.

THE genesis of this volume is explained in the preface. The Council of the Mathematical Association desired to commemorate the bi-centenary of the death of Newton by a special number of the *Mathematical Gazette*. The response to the editor's appeal for contributions was generous and varied. It soon became clear that the limits of a single number would be far exceeded and that interest in the material would not be confined to members of the Association. Hence it was decided to issue it as an independent book. It has taken the form of a symposium of nineteen separate chapters. Mr. Greenstreet is indeed to be congratulated upon the distinguished names that answered his appeal.

Each contributor chose his own subject and treated it in his own fashion. The absence of a connected plan reduces any review to little more than a list of titles. In some of the chapters Newton's name is not much more than a text, and it is the preacher's own views that are heard from the pulpit, which may be more or less interesting according to one's point of view. In this class are Prof. Eddington's treatment of Absolute Rotation, and Prof. Forsyth's discussion of the Problem of Least Resistance. Perhaps Prof. H. E. Armstrong's chapter on the Forms of Carbon and Chemical Affinity should be put under the same class. Others again, though they cannot be said to contain any matter that is not already in print and quite accessible, show a deep and just appreciation of Newton's point of view, admirably presented. Newton's Work in Optics, by Prof. Whittaker, is of this kind, and Prof. Proudman on Newton's Work

on the Theory of the Tides. Rather more might be said of the Rev. J. J. Milne's article on Newton's Contribution to the Geometry of Conics, and Prof. H. Hilton's Newton on Plane Cubic Curves. The lifelong special studies of both authors make their chapters more than historical enumerations. If ever the often desiderated general editor of Newton should appear, he will be very grateful for such articles.

There are several others, indeed, that he will not afford to put by. Mr. D. C. Fraser on Newton and Interpolation is a direct contribution from the author's researches in the Newton MSS. at Trinity College. Mr. J. M. Child on Newton and the Art of Discovery, though not quite of the same class, is truly illuminating as to the kind of tentative construction through which Newton gradually made his way to the binomial theorem and other discoveries. It shows how often the greatest minds climb upwards step by step, rather than leap. Plagiarism in the Seventeenth Century, and Leibniz, provides Prof. L. J. Russell with an interesting theme. Prof. A. E. Heath on Newton's Influence on Method in the Physical Sciences, and Prof. E. A. Bartt on the Contemporary Significance of Newton's Metaphysic, are contributions on the philosophical side. Mr. J. A. Holden, treating of Newton and his Homeland, gives some interesting particulars, but repeats uncritically many exploded fables. Prof. G. N. Watson gives an account of Trinity College in the Time of Newton, but curiously omits to mention his laboratory. Mr. H. Zeitlinger gives an interesting conspectus of the Bibliography of Newton's writings, containing much that would not be easy to find elsewhere. The late Dr. J. L. E. Dreyer was overtaken by his last illness before he was able to complete a promised contribution to the volume, but is represented by some letters he collated from Corpus Christi College, Oxford.

To complete the list of contributions, Prof. D. Eugene Smith contributes three chapters, the first containing Two Unpublished Documents of Sir Isaac Newton, and the second and third on Portraits and Portrait Medals. All three are valuable. But we cannot agree with the pride of place he awards to the portrait by Gandy which is reproduced as a frontispiece. There is one truthful portrait of Newton at least—the death mask, faithfully rendered in Roubiliac's statue. It shows that Newton, like many men of genius, had a receding forehead, with rather blunt features of extreme decision. Gandy has followed the usual convention of a dome-like brow and has given the face delicate features and a general neurasthenic air.

The volume concludes, for no particular reason, with a Latin composition "supposed by the Rev. and learned Dr. Francis Lockier, Dean of Peterborough; reduced into an epitaph by the Sec. of the Gentleman's Society at Spalding," which is in the usual eighteenth century style of such compositions, with its pointless adulation and its long lines and its short lines extending almost *ad infinitum*.

It cannot be said the volume is adequate to the occasion, but what volume would have been? It is an interesting book, for the most part very readable and containing quite a proportion of matter that is either new or well worthy of recall.

European Echinoderms.

(1) *Handbook of the Echinoderms of the British Isles.* By Dr. Th. Mortensen. Pp. ix + 471. (London: Oxford University Press, 1927.) 38*s*. net.

(2) *Les échinodermes des mers d'Europe.* Par Prof. R. Koehler. (Encyclopédie scientifique: Bibliothèque de Zoologie.) Tome 2. Pp. ii + 339 + 9 planches. (Paris: Gaston Doin et Cie, 1927.) 35 francs.

WITH the completion of Prof. Koehler's account of the echinoderms from European seas, and with Dr. Mortensen's English work on those from British seas, the European, and particularly the British, student is fully provided, so long as he takes both books. Dr. Mortensen nowhere precisely defines what he means by British seas, but since he includes the greatest depths, and since, as Prof. Koehler points out, forms found at those depths generally prove to have a relatively wide distribution, therefore, on the probable chance that the British list may be greatly extended, he has comprised in his account the whole of the echinoderm fauna known from the north-east Atlantic. In this respect Dr. Mortensen is more comprehensive than Dr. Koehler; thus, among crinoids he describes the deep-sea forms *Democrinus parfaiti*, *Ilycrinus carpenteri*, *Monachocrinus* 3 spp., *Atelecrinus helgæ*, *Pentametrocrinus atlanticus*, *Trichometra delicata*, and *Orthometra hibernica*; some of these are mentioned, but none described, by Dr. Koehler.

The other classes show the same difference of treatment by the two authors. On the other hand, Prof. Koehler describes twenty-seven species confined to the Mediterranean, many of which are not mentioned by Dr. Mortensen. Eight species marked

by Koehler as special to the Mediterranean do, however, find place in Mortensen's book as Atlantic forms. There are also eleven Arctic species described by Koehler, but not mentioned by Mortensen. It follows that, for a complete account of the European echinoderm fauna in the widest sense, both books are needed.

(1) Dr. Mortensen's "Handbook" is on the same lines as his "Pighude" in "Danmark's Fauna," reviewed in NATURE, Nov. 22, 1924, but naturally includes more species. The tonic accent on the Latin names, which we approved, was apparently beneath the dignity of the Oxford University Press. On the other hand, the index is said to give the English and popular names, but we do not find such obvious examples as 'rosy feather-star,' 'cushion-star,' 'cross-fish,' and 'piper,' not to mention many that might have been taken from Forbes's "British Starfishes." Dr. Mortensen does not seem so familiar with that classical work as one would expect: in referring to a famous passage he gives it on the authority of G. H. Lewes. Forbes used the word 'star-fishes' in a very wide sense, and there is something to be said for Dr. Mortensen's use of 'sea-stars' to denote the 'true star-fishes' as Forbes called them.

In his classification of the Asteroidea, Dr. Mortensen advances a step beyond his Danish book, now giving three orders: Phanerozonia, Spinulosa, and Forcipulata. For the Ophiuroidea he does not see his way to use any of the new classifications, and the orders of Echinoidea also remain as before. Among Holothurioidea the main change is the transference of the Synallactidæ from the Elasipoda to the Aspidochirota. The diagnoses throughout are restricted to those characters necessary when only species from the north-east Atlantic are considered. Special attention is paid to larval forms, parasites, and other ecological features. It seems a pity that a book so admirably adapted to the needs of the working zoologist and the serious amateur should have been produced in a style more suited to the shelf of a reference library than to the pocket or the cabin work-table: it weighs 2 lb. 6 oz.

(2) Prof. Koehler's two volumes (the first was reviewed in NATURE of May 23, 1925) weigh together only 1 lb. 9½ oz., and each will go comfortably into a side-pocket. The whole work costs less than a quarter the price demanded for the English book. The present volume contains the sea-urchins, crinoids, and holothurians. With the last class Dr. Koehler has an intimate acquaintance, and his discussion of some involved questions of specific identity is very detailed. A distinctive feature of this volume is the chapter on geographical distribution and the lists of species according to the following regions: littoral Arctic, abyssal Arctic, littoral Boreal, littoral Lusitanian, abyssal Boreal and Lusitanian, Mediterranean. Still, however, we miss from both books any comparison of the fauna with that in other regions. F. A. BATHER.

Our Bookshelf.

Root Development of Vegetable Crops. By Prof. John E. Weaver and William E. Bruner. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiii + 251. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 20*s.* net.

CONSTANT endeavours to improve crop growth have led to the accumulation of a mass of information concerning the aerial parts of plants and the factors influencing their development. Our knowledge of the underground parts, whether roots or stems, has not increased at the same rate, largely owing to the mechanical problems which render investigation difficult and laborious. This is the more to be regretted, in that the environment of the root can to a large extent be controlled by cultivation and manuring, thus giving scope for the direct amelioration of growth conditions, whereas climatic and light factors, which directly affect the aerial parts, are beyond control by human agency.

Prof. Weaver and his colleagues have already done much to extend our knowledge of the roots of field crops, and in the present volume they continue the investigation into the root system of vegetable crops, thus benefiting the gardener or small grower as well as the farmer. Typical root systems of the more important vegetable crops are described at various stages of growth, and scattered information from various sources is correlated with the results obtained.

The book is rendered more valuable to the practical man by the discussion of root development in relation to cultural practice, in which the advantages and disadvantages of the different soils, methods of cultivation and manuring are considered in relation to individual crops. Knowledge of root systems should enable the grower to combine his various crops to the best advantage, in order that the soil may be adequately filled with roots, drawing evenly on the available plant food, without undue competition in any one place combined with untapped areas elsewhere on the field. The many illustrations are from drawings made *in situ* as the roots were excavated, and the surprising extent of the root systems, even of such a small crop plant as the common radish, gives food for much thought to all, from the amateur gardener to the scientific plant physiologist.

The Theory of Integration. By L. C. Young. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 21.) Pp. viii+53. (Cambridge: At the University Press, 1927.) 5*s.* net.

THE integral calculus was founded two thousand years ago by the Greeks, who applied it with much success to the determination of areas and volumes. Its first appeal to the mathematical world was that of a new and powerful instrument of calculation. When interest was re-aroused in science after the Middle Ages, the infinitesmal calculus developed rapidly under the stimulus of new symbolism, progress being mainly in manipulation until the end of the eighteenth century. Up to then there was little advance on the rigour of the ancients, which, though possibly misplaced, was very severe. There followed a period of criticism, initiated by Cauchy's theory of limits, when the logical ideas at the foundation of the subject were examined. It was found that many of the results obtained by the methods of the calculus would not stand the scrutiny of the new analysis. Such ideas as the treatment of infinite series by the processes of finite algebra were found to need revision.

A still more refined outlook on functions of a real variable was introduced by Cantor in his theory of sets of points. This has been made the foundation of the modern theory of integration by Lebesgue, W. H. Young, and Hobson. In the tract before us, Mr. Young gives a successful exposition of this branch of his father's work in a style that shows much of the vigour and freshness of youth. Although the author stresses the fact that he assumes a minimum of mathematical knowledge, many readers will find the logical sequence of ideas embodied in the tract to be hard reading. Integration is here treated as a subject in itself, apart from differentiation, and the usual fundamental theorem of integral calculus is not mentioned. The complete absence of algebraic manipulation and of even the best-known integrals must be accepted as a tendency of an extensive branch of present-day mathematics, but will appear to some readers as novel. Still, the fact that it is possible to develop a theory of integration on these lines is a striking testimony to the power of the modern treatment. W. E. H. B.

The Performance and Design of Direct Current Machines. By Dr. Albert E. Clayton. (Engineering Degree Series.) Pp. xi+418. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 16*s.* net.

A VERY large number of books have been published on the design of electrical machinery. Most of these contain formulæ which are not much greater help to the designer than rule-of-thumb methods. To give accurate formulæ is impossible, as the reluctance of the magnetic circuit is in general a variable quantity, and the permeability of iron is also variable. The magnetic flux produced by a current is only proportional to the current when the magnetic field has constant permeability, and this assumption can only be made by assuming that the dynamo is built without iron. To assume also that the end connexions of an armature coil have constant 'inductance' is scarcely justifiable. Notwithstanding these assumptions and many similar ones, designers do find formulæ a real help. They are kept on the right lines by comparing their theoretical calculations with the results obtained by experiment. For a particular make of machine, they are soon able to predict the performance with quite satisfactory accuracy.

Dr. Clayton's book is intended for use primarily by students in universities and technical colleges. The reader is supposed to have an elementary knowledge of electrical engineering principles. A balance has been struck between the requirements of a practical designer and the requirements of a student looking forward to an academic examination. For the latter, the numerous examples given at the end of the book, many of which are taken from the University of London papers, will be found very helpful.

The Neurotic Personality. By Dr. R. G. Gordon. (International Library of Psychology, Philosophy and Scientific Method.) Pp. x+300. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1927.) 10*s.* 6*d.* net.

DR. GORDON has presented us with a most excellent book, in which he pleads strongly for a rational viewpoint towards the psychoneuroses. He refers frequently to emergent evolution which forms the basis of his previous book on personality. He gives us a very sound review of the Freudian, Adlerian, and Jungian attitudes towards the neurotic personality, and stresses particularly the need for the study of each case entirely on its merits and its treatment without any preconceived notions, using both pure medicine and psychotherapy; in other words, the application of calm common sense.

The author's opinion that the neurotic never becomes insane will not meet with universal approval. At the same time, he qualifies his opinion by stating that many early cases of insanity are difficult to differentiate from neurosis; in other words, if an apparent neurosis develops into insanity, it was obviously not a neurosis.

Winterstein's Die Alkaloide: eine Monographie der natürlichen Basen. Zweite neu bearbeitete Auflage von Dr. Georg Trier. Erster Teil. Pp. 356. (Berlin: Gebrüder Borntraeger, 1927.) 18 gold marks.

THE first part of the new edition of this standard work on the alkaloids is devoted entirely to a treatment of various classes of bases the constitutions of which have in most instances been settled ("die chemisch näher bekannten Basen"). The sectional headings are (1) aliphatic bases (including amino-acids), (2) aromatic and fatty-aromatic bases, (3) amides, (4) urea derivatives (including the purines), (5) heterocyclic bases of the pyrrole-pyridine group (including coniine, pelletierine, atropine, cocaine, and nicotine). There is a historical introduction of 34 pages, but no title-page, summary of contents, or index is supplied at this stage in the publication.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Transmission of Sonic and Ultrasonic Waves through Partitions.

IN other places I have pointed out that recently devised methods of experiment with ultrasonic waves offer possibilities for a more complete experimental solution of certain acoustic problems than can conveniently be carried out with low or ordinary pitched sounds. A case in point is the reflection from and transmission through material partitions of acoustic waves.

The late Lord Rayleigh, following the classical methods of Green, offered a mathematical treatment of the problem of reflection of longitudinal waves and their transmission through partitions; but the theory until recently had never been tested directly by any experiment. The theory is exact enough for practical purposes, and is analogous to the optical problem of the passage of light waves through a parallel-sided transparent plate. On applying the appropriate boundary conditions in the acoustic problem, it can be deduced that when a train of plane longitudinal waves impinge at perpendicular incidence on a parallel-sided, infinite partition, of homogeneous material, obstructing the waves in a medium, the ratio (r) of reflected to incident energies is given by

$$r = \frac{\left(\frac{V\rho}{V_1\rho_1} - \frac{V_1\rho_1}{V\rho}\right)^2}{4\cot^2 2\pi\frac{d}{\lambda_1} + \left(\frac{V\rho}{V_1\rho_1} + \frac{V_1\rho_1}{V\rho}\right)^2}.$$

Here ρ and ρ_1 stand for densities, and V and V_1 for velocities in the medium and partition respectively. Thickness of partition is d, λ_1 is the wave-length in its material. It follows that when $V\rho = V_1\rho_1$, or what amounts to the same thing, if $\rho\lambda = \rho_1\lambda_1$, λ being the wave-length in the incident medium, r is zero; or in the words of a convenient rule, remembered by a few experimenters, "when the *mass of a wave-length* in incident and reflecting media is the same, reflection is nil and transmission is perfect." Given a solid and large enough plate of any material as reflector, the relation above indicates that the proportion of energy reflected depends on the thickness of the reflector. It is quite possible for a thin plate to cut off more energy than a thicker one, or a thick plate to let through more energy than a thinner one. For if d above equals $n\frac{\lambda_1}{2}$, where $n = 0, 1, 2, 3$, etc., corresponding thicknesses of plate will be integral numbers of half wave-lengths, in which cases the reflection will be minimum and transmission maximum; if $d = (2n+1)\frac{\lambda_1}{4}$ . . ., corresponding thicknesses will be integral odd numbers of quarter wave-lengths and reflection will be maximum and transmission minimum. There is nothing in the theory to prevent its validity at any frequency high or low, but it must be noticed that all considerations of energy dissipation, *i.e.* absorption, within the partition are neglected.

When due precautions are taken, probably the most convenient and accurate method of measuring ultrasonic energy is by the torsion pendulum, the method having been adapted first by Langevin. Types of pendulums and mountings as used by me have been described in *Trans. Roy. Soc. Can.*, **19**, 179; 1925. The vane of a torsion pendulum placed in the track of an ultrasonic beam is itself a small plate reflector of the waves; in consequence its readings should depend on the thickness of the vane, and the pendulum itself may be made to yield information concerning the reflection.

In a short paper (*Trans. Roy. Soc. Can.*, **21**, 115; 1927), describing preliminary experiments carried out some years ago by Mr. J. F. Lehmann and myself, it was shown, by using ultrasonic waves of frequency 135,000 cycles per second travelling in water and striking lead pendulums, that the reflection from the lead was a maximum and transmission a minimum at a thickness of vane about a quarter wave-length; and reflection was a minimum and transmission a maximum at a thickness of half a wave-length. Later, many other experiments of this kind, in which different materials and different frequencies were employed, were carried out by Mr. D. K. Froman and me, with results all similar to the original ones. Recently Mr. D. O. Sproule and I performed a series of *direct* experiments on the same problem, in which the energy transmitted through a metallic plate, intercepting at right angles the path of an ultrasonic beam in water, was measured with a torsion pendulum placed in the 'ultrasonic shadow' behind the plate. The particular frequencies employed were 300,000 and 528,000 cycles per second. Arresting facts like the following were observed. With a frequency of 300,000 cycles per second, a 2 mm. plate of type-metal, which was the obstructing material used in these experiments, could block off completely the ultrasonic beam, while a plate two or four or six times this thickness allowed the larger part of the energy to emerge through it. It was quite clear that, at plate thicknesses of an odd number of quarter wave-lengths, reflection was maximum and transmission minimum, while at thicknesses of a small integral number of half wave-lengths the reverse was the case and nearly all the incident energy got through.

One significant condition prevails in all this work—the velocities as deduced from plate thicknesses work out very appreciably higher than that calculated from Young's modulus and the density. The reasons for this result will later be explained elsewhere. Papers on the experiments referred to are being prepared.

The theory outlined by Rayleigh is straightforward, since analogous theories are accepted for other and all types of vibratory motion. In the case of acoustic waves the half wave-length is the thickness requisite for a *resonant* longitudinal vibration of the reflecting partition. We can imagine a partition or plate of this thickness picking up the incident energy, setting itself in resonant vibration, and handing on the energy through the medium on the other side. At a quarter wave-length thickness the plate, so far as concerns its own vibration, is most inert, offers the most impedance to the impinging waves, and reflects them back.

Considerations of resonance would apply also to partitions which shut off waves of ordinary sound, if the practical conditions usually holding were appropriate. No doubt they do apply in a few rare cases, for example, where the partition can execute 'drum-like' vibration or vibrate flexurally. It may be recalled that Watson (*University of Illinois Bulletin*, **19**, 127) once reported a very interesting and apparently strange experimental result. He blocked up the doorway of a room containing a source of sound with cork boards and on the outside measured the sound energy which got through. He found that a thickness of $1\frac{1}{2}$ in. of the cork reflected less and transmitted more sound than did either $\frac{3}{4}$ or $2\frac{1}{4}$ in. On trying obstructions of *paper-lined* hair-felt he

obtained a similar result. It is likely that some condition of resonance of the partition explains the fact of minimum reflection and maximum transmission at the intermediate thickness.

In materials generally used for sound absorption, such as hair-felt, the sound is transmitted mostly through pores; but the late W. C. Sabine, on finding that the absorbing power of some felts was *a maximum for certain frequencies*, thought it possible that the felt absorbed partly by the dissipation of the waves in its pores and partly by the yielding of its mass as a whole. In an interesting paper on the transmission of sound through hair-felt by Davis and Littler (*Phil. Mag.*, **3**, 177; 1927) the thickness-transmission ratio curves showed not much sign of curvature to indicate any condition of partition resonance at the frequencies used in the experiments; but the authors point out that such is the result only for porous material, and that probably the case would be different with partitions transmitting "an appreciable fraction of the incident sound by diaphragm-like vibration."

R. W. BOYLE.

University of Alberta,
Nov. 21.

The Evidence for Hybrid Vigour in Insects.

IN several reports on the introduction of *Aphelinus mali* into New Zealand and its colonisation, Dr. R. J. Tillyard has stated that by crossing three different strains from America he has produced a more vigorous strain which is now established over the greater part of New Zealand. To quote from one of his articles—"The story of how the three strains of *Aphelinus* were crossed, producing the very vigorous strain which is now being distributed all over New Zealand, is too long to tell in detail here, but the main points may be mentioned."

This aspect of applied ecology or biological control is of great importance to entomologists, and therefore it is necessary to examine the evidence upon which this statement is founded.

Turning to Dr. Tillyard's reports, we find that he received six boxes of parasitised aphis from America, two from Washington State, two from Connecticut, and two from Arkansas. These three consignments were placed together in one breeding box and eighteen specimens hatched. By his own account only five specimens, two females and three males, which hatched out between Feb. 6 and Feb. 15, formed the parents of all his future colonies used in establishing the insect in New Zealand, where they have multiplied and spread and been of great benefit to the country.

The fact that insects are collected from three places, although considerable distances from one another, does not carry with it the fact that they are distinct strains. It is necessary to show some slight biological difference between them. As all the material received was placed in the same breeding box, it is impossible to say whether the eighteen specimens hatched from only the material from one or from two or from all three localities. It is quite possible that they hatched from material from the same locality, and even that they represent one family, being brothers and sisters. Any superiority that might be observed might then be due to an unconscious selection of a superior genetic mutation.

Is there any superiority in the present New Zealand strain, or is their flourishing condition only due to the same factors as caused their host (the woolly aphis) to flourish, namely, congenial climatic conditions, abundance of food, and absence of enemies? Judging by our work in the Hawaiian Islands, I should say that it was so. The idea which underlies this subject is hybrid vigour, and it would be of importance to establish by proper experiments how far this applies to insects. The evidence we have in Hawaii is more in the negative than in the affirmative. In the case of certain Coccinellidæ, inbreeding in captivity has led to reduced fertility, but here we are not quite sure how much of this is due to inbreeding and how much to the conditions of confinement. In a number of cases a small colony has been received from one locality and the insect established in the islands; after many years (some more than twenty) they are as vigorous as ever and show no signs of failing. In certain cases of small parasitic Hymenoptera the insect has carried on generation after generation parthenogenetically, only one or two males ever having been seen out of many hundreds of thousands of individuals. Our examples are not confined to Hymenoptera, but include Diptera, Coleoptera, and Neuroptera.

Most insects that become established in a new country and become a pest are introduced as small colonies from one locality, and in most cases are only introduced once, so that there must be a great amount of inbreeding in a few years. Unfortunately they show no lack of vigour.

The question of hybrid vigour in insects therefore stands in an uncertain condition, and any statement must therefore be supported by evidence for the species in question; no general conclusion can be laid down. In the case in point the necessary evidence is lacking.

While it may be a good policy to get several consignments from different localities when trying to introduce and establish an insect, this is not often possible. Also, the dangers which cannot be entirely eliminated when bringing in a colony are thereby increased. For the latter reason we have always tried to establish our introductions in Hawaii from a single small colony which can be handled more easily. Unfortunately this cannot always be done.

F. MUIR.

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The Radiation from Explosions of Carbon Monoxide and Oxygen to which Hydrogen has been added.

THE speed of explosion of mixtures of carbon monoxide and oxygen is accelerated by the addition of water or substances containing hydrogen, as was shown by Dixon. The acceleration of the speed is invariably accompanied by a reduction in the emission of radiant energy and vice versa (Garner and Johnson, *Phil. Mag.*, **3**, 97; 1927). The radiant energy emitted from these explosions consists mainly of two bands with maxima at 2·8μ and 4·4μ, which are the emission and absorption bands of carbon dioxide. The emitters of this radiation are the molecules of carbon dioxide which have been set in vibration and rotation by the chemical energy liberated during the explosion.

Experiments by Johnson (unpublished) have shown that about 10 per cent. of the total chemical energy of the explosion is emitted as radiation when a mixture of dry carbon monoxide and oxygen is exploded in a long cylindrical bomb 1 inch in diameter. This is reduced to 2·5 per cent. when 1·9 per cent. of water is present. Since the flame of the moist gases is hotter than that of the dry gases, the radiation cannot be entirely black body. At least 7 per cent. of the chemical energy of the dry gases is emitted as chemiluminescence.

Further experiments on dry explosive mixtures to which varying percentages of hydrogen are added, have thrown light on the nature of the effect. The

results are shown in the accompanying diagram (Fig. 1). The currents generated in a thermopile when the radiation from an explosion falls on it, are given as ordinates and the percentage H_2 as abscissæ. The radiation falls very sharply on the addition of 0·07 per cent. H_2, and is still falling slowly when 2 per cent. of this gas is present.

The hydrogen was introduced into an equimolecular mixture of carbon monoxide and oxygen as electrolytic gas.

Since hydrogen has no absorption bands between 2μ and 6μ, it is clear that the reduction of radiation is

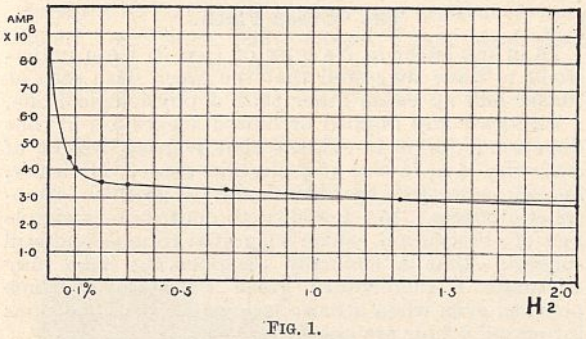

FIG. 1.

not due to absorption in front of the explosion wave. It is also unlikely that the reduction is due to the absorption by water vapour formed in the wave front, for the relation $\log R'/R_0 = kx$ does not apply. (R' is the radiation emitted in the presence of x per cent. of hydrogen, and R_0 is the radiation from the dry gases.)

When the form of the curve is known with greater exactitude, it should be possible to elucidate the nature of the mechanism by which this reduction is brought about, whether it be due to collisions of H_2O, H_2, or H, with the activated molecules of carbon dioxide, or to some other cause.

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F. ROFFEY.
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Subsidiary Rectangles as applied to the Formation of Magic Squares.

WITH non-consecutive numbers it is possible to make an 'associated' rectangle 8×3. It is not possible to do so out of the first 24 consecutive numbers. In using this 'associated' rectangle 8×3 to form a magic square also 'associated,' and 'pandiagonal' with subsidiary rectangles 8×3, it is further necessary that the 3 diagonals one way should also sum to the same amount as the rows. This is so in the following rectangle, where the rows and the diagonals from left to right sum each to 120 and the columns each to 45.

1	23	19	24	22	9	20	2
16	12	5	13	17	25	18	14
28	10	21	8	6	11	7	29

By means of this rectangle two formative rectangles can be made according to De la Hire's method, one 24×3 for the index numbers with 7 replicas, and one for the radix numbers 4×24 with 5 replicas. The resultant magic square will be both pandiagonal and associated with 24 subsidiary rectangles 8×3, each of whose 3 long rows will sum to 3480 and each of whose 8 short columns will sum to 1305. The 24 rows, 24 columns, and 48 diagonals of the square will sum to 10,440. The intervals for the radix numbers I have taken at 30 instead of 29 for ease of calculation.

The above is the smallest rectangle that can be constructed, consisting of 3 rows, that will give this dual requirement, namely, to be associated, and for the diagonals one way to sum to the same amount as the rows; 4×3, 5×3, 6×3, and 7×3 are unable to provide such rectangles without repeating some numbers. This can be proved by algebra.

In the case of 6×3, however, the requirement is not necessary, as squares can be formed in other ways.

I give the following examples to demonstrate this:

4×3

7	(8)	(14)	3
4	(14)	(2)	12
13	(2)	(8)	9

32×24

5×3

(5)	9	14	(11)	1	(24)	29	14	(12)	11
4	10	8	6	12	5	1	18	35	31
15	(5)	2	7	(11)	25	(24)	22	7	(12)

40×24 $\qquad$ 90×54

6×3

79	30	(5)	32	19	(75)
36	29	67	13	51	44
(5)	61	48	(75)	50	1

240×120

7×3

14	(10)	33	30	(26)	12	1
5	20	11	18	25	16	31
35	24	(10)	6	3	(26)	22

126×54

These rectangles are all associated and have their diagonals from left to right summing to the same amount as the rows, but they all repeat numbers in certain places. If in these places numbers are repeated they are not difficult to construct.

With rectangles with 4 rows the necessity for the diagonals one way summing to the same amount as the rows does not arise, but rectangles 6×4 for order 24 are not the smallest that will produce associated squares with subsidiary rectangles 6×4. Order 20 can comply with subsidiary rectangles 5×4, the whole square being pandiagonal and associated. But order 24 can be composed of 24 rectangles 6×4, each one of which is associated and the whole square pandiagonal. This is impossible with subsidiary rectangles 8×3 in order 24 or with subsidiary rectangles 5×4 in order 20.

J. C. BURNETT.
Barkston, near Grantham, Lincs.,
Dec. 20.

The Palæolithic Implements of Sligo.

I THINK that Prof. Macalister and his colleagues have quite fairly stated their opinion (NATURE, Dec. 31, 1927) upon the geological aspect of the sites examined by Mr. Burchell in Sligo. So far as I am concerned, I do not feel entitled to discuss or argue upon the details of this aspect of the matter, for the reason that—as I made clear in my original note in NATURE—I have not yet visited the sites in dispute. I have, however, had abundant opportunities for making an examination of the specimens collected by Mr. Burchell, and of subjecting them to a prolonged and careful examination; and I entertain no doubt whatever that these specimens are humanly flaked, and that their forms and method of flaking are such as were in vogue in Early Mousterian-palæolithic times. Further, I am of opinion that no natural force—or combination of natural forces capable of flaking stone—such as fortuitous pressure, percussion, or thermal action, could in any circumstances produce these forms. This is my sincere belief, and it is because I possess it that I consider it my duty to support Mr. Burchell in this matter.

In these discussions I am always prepared, and perhaps prefer, to stand unaided, and I do not wish, or feel it to be necessary, to call others to my support in this instance. But in the interests of scientific truth it is needful again to direct attention to the fact that every well-known and competent archæologist to whom the Sligo specimens have been shown has, without exception, or any hesitation, accepted them as the work of man. I cannot doubt but that if Prof. Macalister and his colleagues examined these specimens they would also agree with this conclusion. It is because I am convinced that the Sligo material is of human origin I am compelled to conclude that the geological views of Prof. Macalister and his colleagues regarding the Rosses Point site are incorrect. The specimens, too, found by Mr. Burchell embedded deep in Boulder Clay at Ballyconnell, though, I admit, not so conclusively of human agency as those from the other sites, are, I believe, nevertheless artificial, and exhibit the same technique as those discovered at Rosses Point and elsewhere.

J. REID MOIR.

One House, Ipswich.

Sun Images through Window Glass.

SUNLIGHT comes in through an east window and falls upon the whitened wall of a room; a blind is drawn so as to stop the sunlight except for two vertical strips about two inches wide. The two strips of light seen on the wall are not of even illumination, but consist of a series of distorted images of the sun overlapping each other throughout the whole length of the strips. A 'control' to the observation is made by pulling the window down at the top; the overlapping images are not seen now; this is shown in part A of the photograph, which is separated by the horizontal framework of the window from the part B, in which are the 'through the window' images.

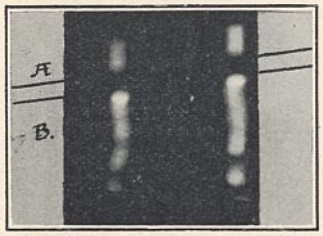

FIG. 1.

The glass is evidently responsible for the effect, though to the naked eye or touch, there is nothing unusual about it.

Perhaps some readers of NATURE would suggest an explanation of the observation.

S. RUSS.

Little Hawkwell, Pembury,
Kent, Nov. 25.

Red Sensitive Photoelectric Cells.

WE have found that it is possible to make photoelectric cells of the Elster-Geitel type sensitive to the extreme red, and having a colour sensitivity approaching that of the eye much more nearly than those used at present. The new cells have a limit above 700$\mu\mu$ and a very useful sensitivity at 650$\mu\mu$; their sensitivity extends also to the violet limit of the visible spectrum, and their total sensitivity to white light is of the same order as that of existing cells.

These cells are not yet marketed in the ordinary way, but we could make a limited number of them available to those who have serious use for them. Inquiries should be addressed here.

Though our process for making these cells works consistently, we do not profess yet to understand it completely. If we described it, we might insist on unessential rather than essential details; and accordingly prefer to postpone a description until our investigations have progressed further.

C. C. PATERSON.
(Director.)
Research Laboratories of the General Electric Company, Ltd., Wembley.
Dec. 5.

The 'Green Flash.'

IF in my letter in NATURE of Dec. 3, I am understood to have suggested that the green flash seen at sunset had no cause other than a physiological one, I withdraw any implied or hinted suggestion in that direction; for it is evident that a great weight of authority is in favour of a physical cause. My letter, indeed, admitted the likelihood of greenish atmospheric effects; but I wished to contribute a simple fact of observation, which suggested to me—and still suggests—that a suddenly disappearing light may stimulate a momentary green sensation in some persons, even when atmospheric and other conditions for actual colour are absent.

It was, I admit, rather hasty to send a letter on so small a point; but readers of NATURE may be glad of the consequent reiterated assurances of high meteorological authorities in the issue of Dec. 17 that the solar occurrence of the phenomenon is objective.

OLIVER LODGE.

Normanton House,
Lake, Salisbury,
Jan. 3.

The Two Calories.

MUCH confusion is caused by the use of the word calorie in two different senses—one to signify the amount of heat required to raise the temperature of one gram of water 1° C., and the other to represent what is really a kilocalorie, or the amount of heat required to raise 1000 grams of water 1° C. The only difference between the means of distinguishing the two units is that the large Calorie is spelt with a capital initial letter, and unless great care is taken this may be set up as a 'lower case' letter by the compositor. May I suggest that the confusion could be avoided—at least so far as the printed word is concerned—by spelling the large unit with a capital letter K, thus, 'Kalorie.' The use of the letter 'k' in this way is in conformity with the principle adopted in the designation of metric units generally.

PERCY L. MARKS.

10 Matheson Road,
London, W.14.

Marsh Gas from Plants.

IN Black's "Lectures on the Elements of Chemistry," published in 1803, there occurs the footnote in reference to marsh gas (spoken of by Black as 'inflammable air'): "The *Dictamnus Fraxinella* emits it from its flowers in such abundance in a calm evening, that it may be set on fire by a candle, nay, take fire of itself."

I shall be very glad if any readers of NATURE can give me information which will enable me to trace this statement to its source, or any information whatever on the point.

ALEX. FINDLAY.

The University,
Aberdeen.

Natural Steam Power Developments at Larderello.

THE problem of utilising the earth's internal heat is no new one, but the general attention of scientific workers and of technologists has been directed to this most interesting topic in a more special manner during these last few years, since a practical application of geothermal energy has been successfully achieved at the Boracic Works of Larderello, in the neighbourhood of Larderello, in Tuscany. This plant, which was originated and brought to its present satisfactory state of development by Prince Piero Ginori Conti, was briefly described in NATURE of Jan. 12, 1924. A few additional details as to further results obtained will doubtless be welcomed by many readers of this journal.

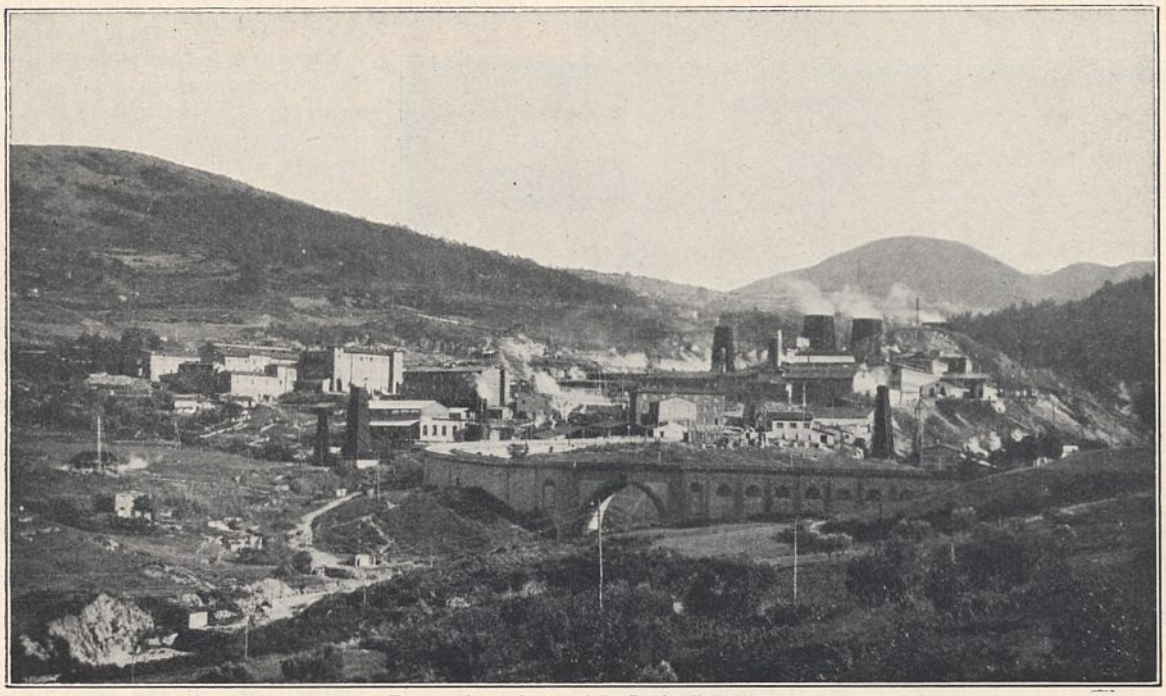

FIG. 1.—General view of the Larderello works.

The fumaroles of Tuscany, better known under the local denomination of *soffioni*, are a notable example of the only form of volcanic activity which is suitable for exploitation, active volcanoes being evidently quite out of the question—at least so far as our present means are concerned. It has been proposed to sink tubes into the hot soil surrounding certain volcanoes, but such schemes do not appear to be practical, as experience has proved that heat transmission, even from incandescent lava, is exceptionally poor, so that enormous heating surfaces would be required to obtain a sufficient quantity of heat to be worth utilising. This observation applies to schemes depending on the utilisation of the geothermal gradient, as by sinking wells to considerable depths in order to reach high temperatures.

Natural steam springs, or fumaroles, are therefore, at the present stage of our experience, the only efficient source of natural heat supply. Very interesting discussions have arisen as to the origin of natural steam such as occurs in California, Oregon, Chile, New Zealand, Java, and Tuscany, where steam springs or fumaroles appear to be a phenomenon allied to vulcanism, but not entailing the immediate neighbourhood of a volcano. Thus, for example, the Tuscan *soffioni* appear to be connected with the trachitic eruptions which took place in central Italy in the latter part of the Tertiary Period, but the traces of these eruptions are found at considerable distances from the spots where the fumaroles are situated. These fumaroles differ, therefore, from those which abound near Vesuvius, Etna, and several other active or quiescent volcanoes, notable among others being those of the "Valley of Ten Thousand Smokes" in Alaska, which issue from the imposing masses of matter erupted from the Katmai volcano, covering a very large area of territory. This latter class of fumaroles is less accessible to investigation, but in some cases, such as the *solfatara* of Pozzuoli near Naples (which is not in the immediate vicinity of Vesuvius, but situated in the crater of an extinct volcano), experiments can be made. A scheme for utilising the *solfatara* of Pozzuoli is being studied.

Modern theories as to the internal structure of our planet lead us to consider that the origin of volcanic phenomena should be traced to magmatic deposits which underlie the upper crust of sedimentary rocks, and in some instances are situated at no very great depth below the surface. The steam which is present (either in its proper form, or dissociated in its component gases) in all volcanic

manifestations is mainly the result of crystallisation of such glassy siliceous magma: phreatic or surface waters, penetrating to adequate depths, are in many cases present and condense the magmatic steam, thus forming almost all the ordinary thermal springs, though the presence of phreatic or surface waters can be traced also in the steam of fumaroles. This theory is supported by geophysical evidence, and has been amply illustrated and discussed in more than one instance, and notably in the case of the fumaroles and thermal springs which abound in the United States. Identical conclusions had been arrived at as a result of the geophysical studies carried out on the district surrounding Larderello, under the patronage of Prince Ginori Conti.

The *soffioni* of Tuscany have been utilised since 1818 for the extraction of boric acid, the presence of which in the waters resulting from the condensation of the natural steam was discovered in 1777, but the production of mechanical power by means of these *soffioni* was begun only in 1904. The first machine with which Prince Ginori Conti made his experiments was a very small cylinder engine which he fed with the volcanic steam used, up to that date, only for heating purposes in connexion with the chemical works and especially with the apparatus for concentrating boric waters. This first experiment was a very important one, as it proved the possibility of working continuously in such conditions with an engine. A slightly larger engine was afterwards tried, with excellent results, and a further step was taken in 1913, when a 250-kw. turbine was installed.

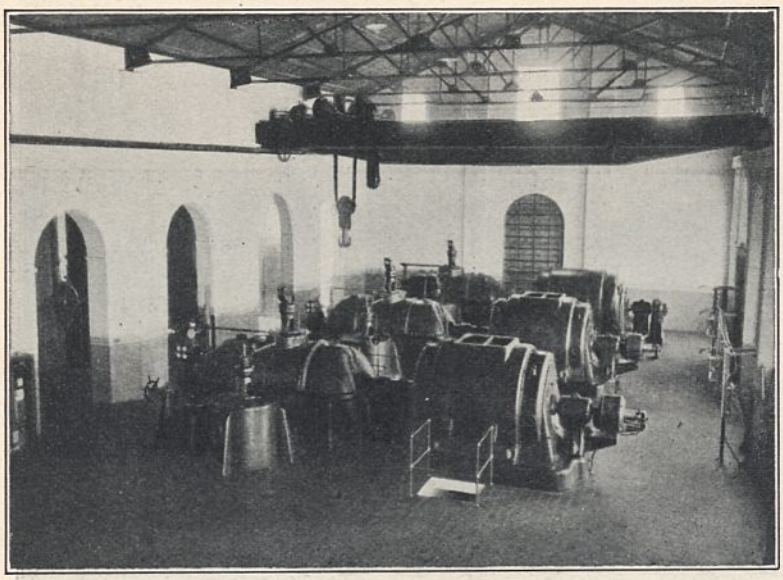

FIG. 2.—The turbine room at Larderello; three turbo-alternators of 2500 kw. each. The turbines are fed with volcanic steam which has been stripped of about 90 per cent. of the accompanying gases.

The steam of the Tuscan *soffioni*, besides boric acid and other substances, including ammonia, is accompanied by a certain percentage of gases, mainly carbon dioxide, with minor quantities of hydrogen sulphide, some methane, hydrogen, nitrogen, and oxygen, and smaller quantities of argon and helium. The presence of such non-condensable gases would have proved a great hindrance to the efficiency of the condensing apparatus required in connexion with turbines, and it was therefore decided to heat, by means of the volcanic steam, appropriate evaporators generating pure steam for feeding the turbines. The same method was adopted when, in 1916, three 2500-kw. turbo-alternators were put up at Larderello. This system, though theoretically correct, did not give very good results in practice on account of leakages often occurring in the evaporator tubes, through which the gases found their way into the turbines and the condensers, greatly reducing the vacuum which is essential to the efficiency of the low pressure turbines (0·25 atm. eff.) used at Larderello.

Considerable improvement was obtained by doing away with the evaporators and substituting, in their stead, special depurating apparatus which eliminates about 90 per cent. of the gas. Such depurators, which are extremely simple, are working most efficiently at the Larderello power station. The non-condensable gases are sent on through pipes to a special department of the chemical works, where carbon dioxide is separated and liquefied: part of it is used at Larderello, together with ammonia which is obtained from the volcanic steam, to make carbonate of ammonia. The depurators also yield a considerable amount of boric waters which are utilised in the chemical department, which, by concentrating the liquors and allowing the acid to crystallise by cooling, extracts boric acid.

More than 5000 kw. is now generated at the Larderello power station, but in the near future three units will be running instead of two, thus adding a further 2500 kw.

The Larderello wells were giving, in the beginning of 1927, more than 120,000 kgm. of steam per hour, but quite recently an exceptionally powerful well was struck, yielding more than 60,000 kgm. of steam per hour at a pressure of 2 atm. eff., so that the supply of steam may be considered as superabundant until sufficient depurators and turbines are installed to deal with it. These very remarkable results are due to the improved methods of drilling which have been gradually introduced. The making of steam wells is an operation which calls for a very careful technique, which can only result from extensive practice in dealing with volcanic soil; it is not exempt from risks, and skilled labour is required, as accidents are not uncommon, steam being sometimes found quite suddenly.

Regular drilling in the volcanic soil of Larderello was begun so far back as 1836, when steam was merely used for its boric acid content, but the old wells were of small depth and their diameters were

also small. Gradual improvements were introduced and outputs of 25,000 kgm. per hour were obtained from single wells when the power station was built; but far better results followed about three years ago at the Castelnuovo works, about 3 miles south of Larderello, where about 60,000 kgm. per hour were given out by a new well at 1 atm. eff., while considerable outputs were available from the same well at a pressure of 3 atm. At the older wells, the output falls rather rapidly as the pressure increases. The pressure of a well attains its maximum when the well is closed down, while the gradual opening of the head valve lowers the pressure as the output increases. Measures of output are made with different gauged tubes, thus allowing a diagram to be plotted showing the linear variation of output with variation of pressure.

The remarkable results of the Castelnuovo well (though not so brilliant as those which have since been obtained at Larderello, as recorded above), besides similar ones at other works, were responsible for the experiment of a small, direct feed, free exhaust turbine which was installed at the Serrazzano works and ran in the most satisfactory manner for more than a year. A further experiment was carried out at Castelnuovo in 1925 with a 650-kw. turbine, which has since been followed by two other 750-kw. units. The Castelnuovo plant is ideally simple, the impulse type turbines being fed directly with the *soffioni* steam : the steam enters the turbine at 2 atm. and free exhaust pressure is about 0·1 atm. All expensive and complicated condensing apparatus, with attendant paraphernalia of pumps, cooling towers, etc., are entirely done away with and exhaust steam is sent on to the chemical department for heating concentrating apparatus dealing with boric waters. During its progress from the turbines to the concentrators, the steam is ' washed,' that is, it is made to give up part of the boric acid which it carries. This operation is performed very simply by allowing a jet of water to enter the pipes conveying the steam, by means of an injector device ; the water dissolves part of the boric acid and is extracted farther down along the piping. This operation, though not always performed in the case of steam used for power generation, is very extensively resorted to in other instances at the Larderello works and provides part of the boric waters used in the chemical department, the remainder being obtained from the soil where natural jets of steam partially condense.

The new Castelnuovo power station, in comparison with the Larderello plant, has a higher steam consumption per kilowatt-hour, but, on the other hand, cost of plant and expenses of running and upkeep are far lower. Each system has its advantages and, where considerations of expense are of paramount importance, while natural steam is abundant, the free exhaust system appears to be preferable.

At the present moment the total output of power generated by means of natural steam at the Tuscan Boracic Works is more than 6500 kw., with the three power stations of Larderello, Castelnuovo, and Lago, the latter being only a small experimental plant generating about 200 kw. New plants are being studied, and it is confidently expected to attain a total power of at least 10,000 kw. The Società Boracifera di Larderello, which owns all the natural steam springs of the district, has eight different works for the extraction of boric acid, at all of which steam is more or less plentiful, and drillings are being actively carried on in most of these works.

Since the first publication, in 1918, of the results obtained by Prince Ginori Conti, other schemes of

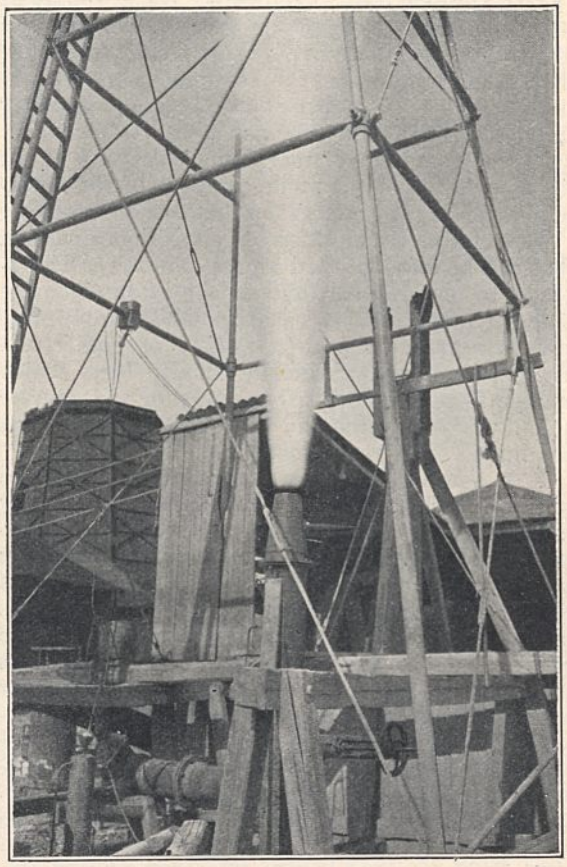

FIG. 3.—A powerful well at Larderello. This well gives more than 60,000 kgm. of steam per hour at 2 atm. efficiency. The steam is seen issuing from a gauged conical tube used for measuring the output of steam.

the same nature have been proposed in different parts of the world, notable among which is that for utilising the important steam springs of Sonoma County in California, commonly, but improperly, called ' geysers.' According to the reports published, the outputs of steam obtained there by drilling are quite notable, but, so far at least, no machinery of any importance has been installed. Other experiments are reported to be in progress in Java.

The Larderello plant is, however, the only concern in the world which is actually working and supplying power derived from natural heat. Larderello is distributing power to the region surrounding the works and is also running in parallel with

the important hydroelectric stations which feed the main distribution lines of the western part of Tuscany.

Another striking feature of the Larderello geothermal plant is the utilisation of natural steam not only with regard to its heat contents but also on account of its chemical components. Power is, in fact, an intermediate product, boric acid and its derivates, carbonate of ammonia and carbon dioxide being the final products. From this point of view also, it is undeniable that the methods applied at Larderello constitute the first successful attempt at a complete and rational utilisation of the volcanic or pseudo-volcanic phenomena through which subterranean heat is brought within reach of human efforts.

Parallel Evolution among Protophyta.[1]

By Prof. F. E. FRITSCH.

THE present-day freshwater Algæ represent the most elementary types of holophytic plant-life to which we have access. The probability that such forms will ever be found preserved in the fossil state in sufficient numbers and showing the necessary details of cell-structure to be of any value for comparative morphological study or for the elucidation of the mode of origin of the multicellular plant, appears at the best to be remote.

The relation of the different types of construction that can be distinguished among the lower Protophyta to one another, and to the more elaborate parenchymatous soma usual in land-plants, must always remain in part a matter of conjecture. There are, however, certain definite facts which emerge from a comparative study of the simpler holophytic organisms and that have an important bearing on these problems.

It is now nearly thirty years since the doctrine of the flagellate origin of the Algæ became firmly established by the discovery in Sweden of Chloramœba and Chlorosaccus. These two simple forms agreed with a number of others in the possession of yellow-green chloroplasts containing an excess of xanthophyll and devoid of pyrenoids, the storage of oil, and the possession of a motor apparatus consisting of two very unequal cilia attached at the front end. These and other minor characteristics served to separate out from the extensive group of the Chlorophyceæ a small set of Algæ which became known by Luther's name, Heterokontæ (yellow-green Algæ). The remainder of the Chlorophyceæ were renamed Isokontæ, a designation based upon the fact that here the motile stages bear equal cilia (commonly 2 or 4). In the Isokontæ the chloroplasts are often large and few in number and are commonly provided with pyrenoids; they contain the same pigments as those of the higher plants and, so far as we know, in roughly the same proportions. Most Isokontæ, moreover, store starch.

Already at the end of last century practically every conceivable type of simple plant-body was known in the Green Algæ, ranging from the motile or motionless unicell, through manifold colonial forms, to a more or less highly elaborated filament. This extremely varied somatic development corresponds to a remarkable range of habitat and goes hand in hand with a great diversity in reproductive processes. There is in fact no other group of simple organisms showing such a wide scope in all these respects. By contrast the Heterokontæ, when first distinguished, included only relatively few forms. By degrees, however, many additional members have been discovered, and in the course of this century it has become increasingly apparent that there exists a far-going parallelism between these two classes, Isokontæ and Heterokontæ, which are so sharply segregated by their metabolism and other features that the vast majority of algal workers have regarded them as quite separate evolutionary lines, in no way related to one another.

The Heterokontæ do not, however, exhibit anything approaching the multiplicity of forms that are seen among the Isokontæ; in particular they do not appear to have evolved the motile colony. The less vigorous development accords with the fact that only a few of the more specialised members of the class exhibit sexual reproduction and that this has not passed beyond the phase of isogamy.

The ciliated members of Heterokontæ without exception show 'flagellate' characteristics; that is to say, they are devoid of a cell-wall, their plasma-membrane (periplast) is more or less rigid but usually admits of some change of shape, multiplication is effected by longitudinal division, the protoplast readily encysts, and sexual reproduction is not known to occur. Some of the palmelloid members (*e.g.* Chlorosaccus), possibly all, also show these features. The many motile and palmelloid types among the Isokontæ are, on the other hand, for the most part on a higher plane of organisation and reproduction, being true Algæ provided with a firm cell-wall and usually exhibiting sexuality. When, however, the parallelism between the two classes is recognised, the distinction between flagellate and algal organisation loses force, and it is realised that the assumption of 'algal' characteristics has taken place at an earlier stage in the evolution of the one and at a later stage in that of the other.

These conclusions, however, do not apply only to Isokontæ and Heterokontæ. It is now clear that, in *all* the classes of pigmented Protophyta, an analogous evolutionary sequence has been followed, but that the features associated with what may be called 'algal organisation' have appeared, if at all, at different points in the sequence in the diverse classes. It is no longer feasible to separate the Algæ from the holophytic Flagellata as distinct

[1] From the presidential address to Section K (Botany) on "Some Aspects of the present-day Investigation of Protophyta," delivered on Sept. 1 at the Leeds meeting of the British Association.

groups of Protophyta. There is reason to believe that every series of holophytic Flagellates could potentially have acquired algal characteristics, although on the present evidence some have failed to do so.

These points are well illustrated by a consideration of Pascher's Chrysophyceæ which, until relatively recent times, were only known to include a wealth of flagellate types, the Chrysomonadales, represented by motile unicells (*e.g.* Chromulina, Ochromonas), by motile colonies (Synura, Uroglena, etc.), and by numerous epiphytic forms. The palmelloid type is also well represented, reaching an exceptionally high differentiation in Hydrurus. But within the last dozen years a quite considerable number of algal members of this class have been discovered on the Continent (for example, Chrysosphæra, Thallochrysis), and it is clear that the Chrysomonadales too have progressed in the same direction as Isokontæ and Heterokontæ, but that here the bulk of the forms have remained flagellate and the minority have become algal.

Another striking instance may be mentioned. The Peridinieæ (Dinoflagellata) are a very distinct and rather specialised class of motile forms, abundant in freshwater and marine plankton. Their most striking characteristic lies in the division of the body of the cell into two usually slightly unequal halves by a transverse furrow harbouring one cilium, whilst the other trails out behind into the water.

In 1912, Klebs described a number of forms that were clearly algal members of this class. His Hypnodinium shows the derivation clearly; it consists of large motionless spherical cells provided with a firm membrane and possessed of the chromatophores and nuclei characteristic of the class. When reproduction takes place, the protoplast contracts somewhat and develops the distinctive furrows, but this is followed by division without resort to a motile phase.

As an antithesis to classes like the Chrysophyceæ and Peridinieæ we have the Myxophyceæ (Cyanophyceæ), where motile types are altogether unknown and all the forms exhibit an algal organisation. Even in this very sharply circumscribed class a considerable degree of parallel with those previously considered can be recognised. Other distinct classes of Protophyta exhibiting holophytic nutrition, but of more restricted range and generally showing special development in one direction or another, are the Bacillariales (Diatoms), the Cryptophyceæ (including the flagellate Cryptomonadineæ and a few little-known algal types), the Chloromonadineæ, and the Euglenineæ. In all of these, one or other organism can be recognised as parallel with types in the classes that have been previously discussed, although none has evolved the branched filamentous habit so far as at present known. It seems clear that in all the nine classes mentioned evolution has progressed along similar lines and in many cases has led to the production of analogous forms of plant-body.

Amongst the numerous filamentous Isokontæ it is possible to distinguish four separate series, of which the Oedogoniales and Conjugatæ are specialised along directions of their own. Of the other two, the Ulotrichales are the simpler and the Chætophorales the more complex, both possibly originating from a common stock. Many authorities, in fact, fail to distinguish these two groups, but the organisation of the Chætophorales is so distinct from that of the Ulotrichales that, from the viewpoint of comparative morphology, their separation is desirable. Whereas in the Ulotrichales we have a simple or branched filament attached by a more or less elaborate basal cell, the central types among Chætophorales are distinguished by the possession of a plant-body showing differentiation into a prostrate system of creeping threads, serving *inter alia* for attachment to the substratum, and a projecting system which is more or less richly branched.

This type of construction is not encountered in any of the other nine classes of Protophyta previously mentioned. An analogous differentiation of the filamentous thallus into a creeping and a projecting system is, however, characteristic of many Ectocarpales (*e.g.* Ectocarpus) and Nemalionales (for example, Chantransia), which include the simplest known members of the Phæophyceæ and Rhodophyceæ respectively. In fact, it appears that this kind of plant-body represents a definite stage in the evolution of various classes of Protophyta, affording another instance of parallelism. But, whereas in the Isokontæ it represents the most advanced type of which we have any knowledge, in the two great marine groups it is seen in the simplest of the present-day forms, since no unicellular or palmelloid members of these classes are certainly known to exist.

Of all the holophytic Protophyta, the Phæophyceæ and Rhodophyceæ have alone attained to a high degree of morphological and anatomical specialisation, often affording in one feature or another marked instances of parallel with those groups of the vegetable kingdom which are now dominant on the land. The totally differing metabolism obviously renders impossible, however, any direct derivation of the land-flora from forms belonging to either class.

It will be generally agreed that we must seek the origin of terrestrial plants in organisms possessing the same plastid-pigments and the same essential metabolism as they do. The only representatives of such forms among Protophyta at the present day are afforded by the numerous Green Algæ, the Isokontae. These, however, as has previously been pointed out, stop short at a level of morphological differentiation of the thallus at which the two marine groups commence. Roughly speaking, too, the stature of the most highly differentiated Isokontæ is approximately equivalent to that of the simpler Brown and Red Algæ.

In the Isokontæ we thus have a class of great morphological diversity in which almost every conceivable type of simple plant-body has been realised and is still existent at the present day, but which stops short at a massive parenchymatous construction and forms of large stature. In the

Brown and Red Algæ, on the other hand, where no simple forms of plant-body are certainly known, plants of large size and possessed of a highly developed parenchymatous soma are abundantly represented. It appears improbable that a class like the Isokontæ, showing such extreme capacity for morphological elaboration in every direction and for adaptation to very diverse habitats, should have failed to develop further in the direction generally indicated by Phæophyceæ and Rhodophyceæ. Moreover, it must be remembered that they possess the photosynthetic equipment which has evidently proved to be the only successful one on the land, and that practically every group and family of Isokontæ has its terrestrial representatives.

What then, it may be asked, has become of the more highly elaborated members of this class? It seems to me that there is every reason to suppose that, approximately at the level of morphological differentiation and stature reached by the Isokontæ of the present day, the terrestrial habit was adopted in the remote past, that the more highly elaborated Green Alga became a land-plant, the early forms of which are perhaps yet to be disclosed by palæontological research. In this connexion it is not without significance that the oogamous members of this class for the most part occupy a peculiarly isolated position, appearing as outliers well in advance of the rest, although for none of them is there, to my thinking, any possible connexion with the higher land-plants.

If one recognises among Phæophyceæ and Rhodophyceæ many features of anatomy, life-history, etc., that recall the characteristics of land-plants, I can see in that only a confirmation of the belief that environment has little to do with the broad evolution of the plant-organism, and that these features are a natural outcome of the evolutionary trend in the vegetable kingdom and no positive evidence for the view that they must necessarily have originated in a marine environment. The comparative study of the simpler forms of plant-body in the different classes of Protophyta lends great support to such a concept of a general evolutionary trend.

Obituary.

Prof. Bertram B. Boltwood.

THE tragic death on Aug. 14, 1927, of Bertram B. Boltwood, professor of radiochemistry in Yale University, removes an outstanding scientific personality who played an important part in the rapid expansion of our knowledge of radioactive transformations in the early days of radioactivity. Prof. Boltwood was born on July 27, 1870, in Amherst, Mass. His father, a graduate of Yale, was of English descent, and his mother of Dutch extraction. He entered the Sheffield Scientific School of Yale in 1889, taking chemistry as his chief subject. After graduation he spent two years at the University of Munich under Prof. Krüss, paying special attention to analytical methods and to the rare earths. The knowledge and technique thus gained was to prove of great importance in his subsequent researches in radioactive minerals. In 1894 he returned to Yale as an assistant in the chemistry department, and did some research work both in organic and inorganic chemistry. In 1900 he left the University to take up work as a consulting chemist, but continued research in his private laboratory.

It was during this period that Boltwood became interested in the study of uranium minerals and the possible genetic relations between the radioactive elements. In 1903, Rutherford and Soddy had put forward the disintegration theory of the radioactive elements and had indicated that radium might prove to be a transformation product of uranium. If this were the case, radium should grow from uranium, and the amount of radium in old unaltered minerals should be proportional to their content of uranium. It was to this latter problem Boltwood first devoted himself in 1904. This involved a systematic chemical analysis of minerals for their uranium and radium content. The amount of radium with the uranium in solution was determined by boiling off the emanation and introducing it into an electroscope. This method in Boltwood's hands became a weapon of precision, and he was able to show that in properly selected minerals the amount of radium was always proportional to the amount of uranium, thus proving that a genetic relation existed between them. If uranium were transformed directly into radium, a solution of uranium, initially freed from radium, should grow radium at a rate that could easily be measured in a few days or weeks. He found, however, no trace of the growth of radium in a carefully purified solution of uranium over a period of about one year, and concluded that an intermediate product must exist between uranium and radium. We now know, due to the work of Soddy, that radium ultimately does appear in uranium solutions, the growth depending on the square of the time; but the small amount of radium produced in the first year is difficult to detect even by the delicate emanation method.

Investigations were then made to see if it were possible to isolate chemically from a uranium mineral the intermediate substance which is transformed directly into radium. A radioactive body was separated which Boltwood found grew radium at a rapid rate. From the similarity of the chemical properties of this body with those ascribed at that time to actinium, he naturally concluded that actinium was the direct parent of radium. Later investigations, however, showed that the properties of actinium had been wrongly described, and that the parent of radium was not actinium at all, but a new radioactive element which he named 'ionium.' In these experiments some thorium was added to the uranium mineral to effect a complete separation of the ionium. Boltwood found that it was impossible by chemical methods to separate the added thorium from the ionium. This

was one of the first cases observed of inseparable elements, of which a number of examples came to light in later years. It was on observations of this character that Soddy later put forward the conception of isotopes which has proved to be of so much significance not only for the radioactive but also for the ordinary elements.

By comparing the rate of growth of radium in the separated ionium with the amount of radium in equilibrium with uranium in the mineral, Boltwood was able for the first time to fix by a direct method the average life of the radium atom. In later researches he was able to show that a genetic relation also existed between actinium and uranium, but that the amount of actinium was only a few per cent of that to be expected if it were in the main line of descent. This work suggested that the actinium must be regarded as a branch product at some point of the uranium-radium series. This is a conclusion we hold to-day, but the exact point of branching is still uncertain.

These investigations, which were carried out with great experimental skill and accuracy, thus yielded results of fundamental importance. Boltwood had not only proved a genetic relation between uranium and radium, but also had isolated the new element which was the immediate parent of radium, and had shown that actinium was also genetically connected with uranium but not in the main line of descent.

I must not omit here to refer to another deduction which has proved to be of great importance. As a result of his own analyses and the analyses of Hillebrand, Boltwood found strong evidence that the amount of lead in old minerals of the same geological age is proportional to their content of uranium and increases with the geologic age. This led him early (1905) to suggest that lead was the final inactive product of the uranium-radium series of transformations. The correctness of this view has been abundantly verified in recent years. We know that the end product of uranium is an isotope of lead of atomic weight 206, and the end product of the thorium series is another isotope of weight 208. These observations have thus supplied a definite method of estimating the age of radioactive minerals and thus of the geological horizons in which they are found.

The importance of Boltwood's work was at once recognised by Yale University, where he was appointed assistant professor of physics in 1906 and professor of radiochemistry in 1910. He took an active part with the late Prof. Bumstead in building the new Physics Laboratory in Yale, and later, in 1918, as professor of chemistry, in building the new chemical laboratories. The labour and detail involved in such undertakings, which he cheerfully undertook, made serious inroads not only on his time for research but also on his energy. He had a breakdown in 1922, and never completely recovered from its effects.

I first made the acquaintance of Boltwood in 1904, when he was carrying out his first radioactive experiments. One could not fail to be impressed by the breadth and accuracy of his scientific knowledge, and by his scrupulous care and accuracy in experimental work. He possessed to an unusual degree the power of anticipating experimental difficulties which were likely to arise and in arranging his apparatus and methods to overcome them. This characteristic feature of Boltwood's work was well illustrated in his investigations with me in the University of Manchester in 1910 on the rate of production of helium by radium and other radioactive bodies. Every detail of the complicated apparatus and arrangements was so carefully thought out beforehand that not a single change was required for the successful conclusion of the measurements.

A man of cosmopolitan tastes, Boltwood was much attracted by many aspects of European life and spent many of his summers on the Continent. He took an active interest in the undergraduate life of his university and had the gift of gaining the interest and confidence of young people. His premature death will be mourned by a wide circle of friends, who held him in high esteem for his personal qualities as well as for his outstanding scientific achievements.

E. RUTHERFORD.

MR. W. H. DINES, F.R.S.

BY the death of Mr. William Henry Dines, meteorology loses an outstanding figure. It is scarcely possible to overrate the importance of his work. He was a meteorologist of the first rank before he began the upper air work for which he is best remembered. Born in 1855, he was the son of George Dines, himself a meteorologist of note. He was educated at Woodcote House School, served an apprenticeship as a railway engineer, and then went to Christ's College, Cambridge; he obtained first class honours in the Mathematical Tripos, and took his B.A. degree in 1881. The bent of his first meteorological work was occasioned by the disaster to the Tay Bridge, which, only recently opened, was destroyed by a gale while a train was crossing it. So George Dines investigated wind pressure and his son helped him. Later, as a result of this work, W. H. Dines designed the pressure tube anemometer. This instrument in its final form records each gust of wind and each transient change of direction, and is the standard recording anemometer for all serious purposes.

Dines's most notable work, that of upper air research, began in 1901 with kite ascents. When possible, Dines always preferred to design and make his own apparatus, and it was his modification of the box kite, his winding gear, and his meteorographs which were used. The meteorograph was simple, efficient, and cheap, a great point for upper air research, when instruments are apt to be lost or broken. Dines took observations at Crinan, on the west coast of Scotland, in the summers of 1902 and 1904, flying kites from a shore station, from a tug in 1902, and from H.M.S. *Seahorse*, lent by the Admiralty for the purpose in 1904. He also used his house at Oxshot in Surrey, and later at Pyrton Hill, near Watlington, as an upper air observatory.

As the investigation progressed, greater heights were required than could be attained by kites, and Dines used sounding balloons. His balloon meteorograph with its metal case weighed only two ounces, and cost only about one-twentieth of the price of instruments used on the Continent and in the United States. Being so light it allowed much smaller balloons to be used. The whole cost and difficulty of sounding balloons were so much reduced that the Department of Physics at the University of Manchester was able on two occasions to send up a balloon every hour for twenty-four hours. He designed also a very ingenious apparatus for calibrating the meteorographs. Accounts of these and many other instruments, and many papers on meteorology, especially on wind pressure, upper air research, and, later, on radiation, are to be found in the publications of the Royal Society, the Royal Meteorological Society, the Meteorological Office, and elsewhere.

Dines had a wonderful insight as to what was necessary in an instrument. He could design it, make it himself in many cases, use it to the best advantage, and afterwards discuss the results obtained. It was the possession of these qualities, seldom all united in one person, that marks the genius that he applied to meteorology. It was as an amateur that he worked. Most sciences have been started by amateurs, but by degrees they have grown out of the stage when an amateur can usefully apply himself to their problems. Meteorology has possibly reached this stage. Dines was the last and the greatest of the amateurs who built up the science, and he has left it in a very different condition from that in which he found it. Now it is recognised as a real science worthy of study by mathematicians and physicists of the first rank. He had a great share in bringing it to this stage.

Most of the sounding balloon work was done by Dines at Benson, near Wallingford, where he went from Pyrton Hill. It was chosen as being in a part of England most favourable for balloon ascents. Dines himself hoped that Benson would become ultimately a permanent aerological observatory, and indeed at one time this was to have been its destiny. Fate, however, intervened, and to the regret of many the dream will not come true.

Dines joined the Royal Meteorological Society in 1881; he was for a number of years a member of council; he was president in 1901 and 1902; and in 1914 he received the Symons Gold Medal of the Society. In 1905 he was elected a fellow of the Royal Society. From 1905 until 1922 he was Director of Experiments on the Upper Air for the Meteorological Office, and a small annual grant was made for the maintenance of the establishment, first at Pyrton Hill, afterwards at Benson; but Dines received no personal emolument; so far as his own services went, his position was an honorary one. Perhaps because he was never in the employment of any Government office, or the holder of any public post, perhaps because he was of a very modest and retiring nature, and would never have dreamt of pushing himself into public notice, he received no public honour of any kind. Probably in no country but Great Britain would such eminence in a science which has become of such great practical importance have passed unrecognised.

Dines was a real student, wrapped up in his work, and in the subject he had made his own. He was singularly retiring, and had the constitutional shyness which not seldom goes with genius. But those who penetrated his reserve found that he could have, and maintain, strong opinions, and that he had a quiet but very real sense of humour. He was ever ready to help others who were working on the same lines as his own, and took infinite pains in this way, as the writer can testify from the experience of many years. He is survived by a widow, and by two sons who carry on the family tradition of meteorology into the third generation, for they both have posts in the Meteorological Office.

The early years of the century will stand out by reason of great advances made in many sciences, especially in physics and astronomy. Meteorology advanced rapidly at the same time, and in Great Britain it was Dines who led the way. Physics and astronomy are still in the period of rapid advance. Meteorology shows signs of decreasing acceleration. Can we look forward to a further advance, which only research can ensure? Given the will, it is possible; but we shall not so easily find again the genius of a Dines. C. J. P. CAVE.

DR. HERMANN KAST, well known for his work on explosives, died on Sept. 6, 1927, aged fifty-eight years. After a period of study in A. W. Hofmann's laboratory in Berlin, Kast graduated in 1893. For many years he was a member of the council and deputy-president of the Berlin Bezirksverein deutscher Chemiker. In addition to numerous original scientific publications, Kast published two comprehensive works dealing with explosive materials.

WE regret to announce the following deaths:

General Henry L. Abbot, the distinguished U.S. Army engineer, who was elected a member of the National Academy of Sciences in 1872, on Oct. 2, aged ninety-five years.

Mr. Leon Gaster, honorary secretary of the Illuminating Engineers' Society, on Jan. 7, aged fifty-five years.

Prof. H. W. Mackintosh, formerly professor of zoology and comparative zoology in the University of Dublin, a post which he held for nearly fifty years, on Jan. 8.

Dr. Frederick C. Newcombe, emeritus professor of botany in the University of Michigan, and secretary in 1897 of Section G of the American Association for the Advancement of Science, who worked particularly on the sensitive reactions of plants, on Oct. 1, aged sixty-nine years.

Dr. Geo. A. Osborne, emeritus professor of mathematics at the Massachusetts Institute of Technology, on Nov. 20, aged eighty-eight years.

Prof. F. W. Very, director of the Westwood Astrophysical Observatory at Westwood, Mass., since 1906, on Nov. 23, aged seventy-five years.

News and Views.

TUESDAY last, Jan. 10, marked the one hundred and fiftieth anniversary of the death of Linnæus. Carolus Linnæus—afterwards Carl von Linné—was born on May 23, 1707, the eldest child of Nils Linnæus, pastor of South Råshult, in the south of Sweden. After a schooling that lasted until he was twenty years old, Linnæus spent one year at the University of Lund and five years at the University of Upsala, the latter period interrupted by his famous five months exploration of Swedish Lapland in the summer of 1732. Then followed a fruitful three years' sojourn abroad—mostly in Holland, but with visits to England and France—succeeded by three years as a physician in Stockholm. Finally, he was appointed in 1741 to the chair of natural history in Upsala, a post which he held until his death.

IF we make in modern fashion a fanciful aeroplane survey of the rich, varied, vast, and ever-broadening territory occupied by the biological sciences during the last one hundred and fifty years, it is easy to lose sight of the small tract of thorny wilderness out of which they were trying to struggle before the coming of Linnæus. Before him there were pioneers like Bauhin, Gesner, Ray, and Tournefort, who had attempted to clear a track to the open country, but it was Linnæus who transformed their cumbersome and uncertain direction finders into instruments of precision, who brought the wanderers out of the jungle and laid down a base line for the survey of the promised land beyond. Although Linnæus had but a glimpse of the fair regions which those who have come after him enjoy, and although some of his instruments have been superseded and others refined, his base line still remains. All collective knowledge depends on the correct and accepted use of names, and the incomparable service rendered by Linnæus in his "Species Plantarum," "Systema Naturæ," and other works, was to establish, in the study of all things that live or have lived, an accurate and universally accepted system of nomenclature. To amplify the expression of one of the greatest of living zoologists, Linnæus was the Adam of the biological sciences. So all who labour to increase man's knowledge of himself and all other creatures, great and small, do well to hold his name in honourable remembrance.

METEOROLOGICAL conditions, and especially the swollen state of the upper Thames resulting from the melting of snow, had doubtless a good deal to do with the recent abnormal tides and floods which caused loss of life and much distress in Westminster and low-lying parts of London. There were also astronomical factors to reinforce the effects of the gale and the swollen river. The night tides at winter full moons are helped by the north declination of the moon at such times. On Saturday morning, Jan. 7, the moon's north declination was 25°, so that it was only 26½° from the zenith in London, and the sun was only 28° from the nadir. Also the sun was near the earth, having passed perihelion on Jan. 4. The moon was in perigee late on Jan. 3, and was still considerably nearer the earth than its average distance. The night tides at full moon are higher than the day tides, the moon being nearer in the former case by nearly the diameter of the earth. The day tide at midsummer new moon is also high, but less so than the midwinter night tide, owing to the greater distance of the sun. The conditions on Jan. 7, when the floods occurred, were not the most favourable possible, the moon being more than three days from perigee, but they were much above the average. The actual conditions are less simple than those sketched here, the British tides depending on the conditions in the ocean at some distance away, rather than on the direct action of the moon on the narrow seas round Great Britain. It is for this reason that the highest spring tides do not generally come until one and a half days after new and full moon. But on Jan. 7 the highest tide appears to have come on the actual night of full moon; this must have been due to the prevailing meteorological conditions, which piled up the water in the North Sea and prevented the flow out of the river, rather than to astronomical causes. The tide is said to have reached the highest point ever known in the Thames.

THE Egyptian Minister of Education has just issued invitations for the celebration next December of the centenary of the Faculty of Medicine in Cairo, which is to take the form of an International Congress of Tropical Medicine and Hygiene under the patronage of the King of Egypt. The chequered history of the Cairo School of Medicine presents a number of incidents that suggest romantic stories from the Arabian Nights rather than sober history. From the time of the famous Alexandrian School of Herophilus and Erasistratus, which created the systematic study of anatomy, there was nothing worthy of the name of a medical school in Egypt until a century ago. The story goes that one afternoon the Viceroy, Mohammed Ali, was driving through the streets of Cairo on the way to the Shubra Palace when he ordered his coachman to stop and, summoning a well-dressed Frenchman who was walking along the street, informed the stranger that he wanted him to create a medical school in Cairo! When the latter protested that he was a wine merchant and not a medical man, the Viceroy refused to listen to his excuses and insisted on his orders being carried out.

CLOT BEY, in spite of his ignorance of medicine, was an able man, who accomplished the task thus entrusted to him with conspicuous success, which was recognised later by the conferring of the M.D. degree on him by the University of Paris. Napoleon I. had founded a military hospital in Cairo, and around the civil hospital which afterwards replaced it, and later was transferred to Kasr el Ainy, the medical school was built up. Among the able staff which Clot enlisted was the anatomist Bilharz, whose discoveries in helminthology have made his name familiar to every student of medicine. Thirty years ago the late Lord Cromer recommended the reformation of the School, which

had become moribund. Acting on the advice of Sir Cooper Perry, the school and hospital were in large measure restaffed and developed in accordance with British ideas, so that they became important instruments of medical education and research. With the granting of Egyptian independence, the medical school passed under the control of the new Egyptian university. The Congress marking the centenary of the school should be one of exceptional interest.

IT is unlikely that the attempts which are being made in the French press to discredit the findings of the International Commission on Glozel will carry any weight with those who are competent to form a judgment on the evidence. If, however, there should be any who still, after the publication of the Report, find a difficulty in forming an opinion, they should be convinced by Sir Arthur Evans's letter in the *Times* of Jan. 7. Not only does he fully endorse the findings of the Commission, but he also thinks they might have found stronger expression. He points out that beyond the material findings to which the Commission has confined itself, there are certain considerations which should be borne in mind. "To accept as genuine," he says, "the accounts of these discoveries would be to destroy the whole fabric of our knowledge of the successive stages of the earlier and later Stone Ages." He goes on to point out how the immediate juxtaposition of the Magdalenian period and Glozel, itself dated no earlier than the end of the neolithic period at Knossos, runs counter to our knowledge of the stages later than the Magdalenian and ignores the high antiquity of the neolithic period, the stratified deposits of which at Knossos lie in places to a depth of 36 feet below the earliest Minoan, itself extending well into the third millennium B.C. Sir Arthur's pronouncement on the finds themselves, which he has now examined personally, will be welcomed by archæologists. In his opinion they are one and all the work of the same industrious hand, and "it is difficult to understand how they can deceive any expert eye." They present the most startling incongruities; the culture is of all ages, while the script contains selections from historic alphabets. The tiles of the glass furnace supplied the models for the bricks, its crucibles for the 'mud-pie' pots, and the inscriptions were derived from the collections or publications of M. Perot of Moulins, a local antiquary.

AT the annual meeting of the Geographical Association, held on Jan. 4-7 at the London School of Economics, Dr. Marion I. Newbigin delivered a lecture directing attention to the need for a new approach in geography teaching. Too much emphasis has been laid, she said, on the logical sequence beginning with climate and leading on to a study of vegetation and human activities. Arithmetically determined 'means' are of little use for children and do not lead to an appreciation of actual climatic conditions. The study of house types should take the place of climatology, which is too prominent a feature of geography teaching. Of supreme importance is the organic response to normal and usual conditions and the degree of tolerance of the abnormal. Sir John Russell, in discussing the agricultural problems of Palestine, showed the necessity for afforestation in that country. The run-off from the arid Jordan slopes of the Judean Highlands is so rapid after torrential rains that the soil is washed away. If trees were to be planted, their roots would hold up the water and springs would issue from the hillside. This water could be regulated and utilised for irrigating fruit gardens in the valley below. Mount Carmel should be re-afforested for the benefit of the Plain of Esdraelon, the swamps of which are being converted into irrigable land. Stock-raising difficulties are the result of the spread of diseases by the flocks and herds of Bedouin nomads. These animals are also responsible for serious depredations among newly planted cypress and fig saplings in the recently afforested areas between Jerusalem and Jericho.

PROF. RODWELL JONES, speaking at the annual meeting of the Geographical Association on the economic development of the Prairie Provinces of Canada, stressed the importance of irrigation in Western Alberta, where the climate favours the growth of hard wheat with a high gluten content. No storage works are necessary in the mountain zone, since the maximum flow of the rivers coincides with the opening of a short growing season. Nevertheless, irrigation is too expensive for general adoption. Vancouver is the main outlet for the region, although the completion of the Hudson Bay Railway to Fort Churchill, not Fort Nelson, is to be hastened. The coal reserves on the Prairie, though easy to extract, are of an inferior quality with a high ash and water content; they crumble on prolonged exposure and have a low calorific value. High-grade coal of the mountain region is difficult to mine. Sir E. Humphrey Leggatt, who delivered a lecture on "Economics and Administration in British East Africa," spoke of the Commission about to visit East Africa to consider possibilities of greater unification in the government of the area. He referred to the growing public demand for news relating to East Africa, especially that concerned with morals. He questioned the advisability of delimiting native reserves, and spoke in high terms of the system of interpenetration adopted in Uganda and Tanganyika Territory. This scheme recognises native rights to the land, and only very small blocks are alienated to Europeans. The total available native labour is inadequate for the vast European estates in Kenya, and further immigration of Europeans, together with additional alienation of land, is not for the good of the colony. It is important to avoid the development of a 'poor white' class as in South Africa.

A STATEMENT by Sir John Marshall that a monograph on the important excavations in the Indus Valley will appear in the coming summer is welcome news to archæologists. They have long awaited the opportunity for careful consideration of the finds on the two sites of Mohenjo-daro and Harappa which will be afforded by the fuller publication of results now promised. In the meantime, Sir John Marshall, in the *Times* of Jan. 4 and 5, has given some account of the

more recently obtained material, and has surveyed the general conclusions to which he has been led by maturer consideration. Of these, perhaps the most important is the view that the early culture which has been revealed here should not be regarded as Indo-Sumerian but should be known as 'Indus' culture, on the ground that there is not so much identity of culture in Sumeria and Northern India as a close connexion due to commercial or other intercourse. As regards dating, Sir John Marshall suggests that the Indian seals found at Susa and elsewhere in Mesopotamia, belonging to the time of Sargon I. of Akkad (2700 B.C.) or before, would give a date of about 3300 B.C. for the first of the three latest cities at Mohenjo-daro, the uppermost cities at Harappa being about contemporary. This would give a very early date for the lower cities with the primitive seals and other antiquities on the latter site.

So far as evidence has been obtained, the inhabitants of Mohenjo-daro were of the dolichocephalic type, with the exception of one brachycephalic skull from a burial. But although they all belong to the chalcolithic period, they were long after the destruction of the latest city. One of the most interesting objects found at Harappa was a model in copper of a two-wheeled cart which, if the dating is correct, would long antedate the representation of a wheeled vehicle recently found at Ur, which in turn antedates the use of the wheel in Egypt by a thousand years. It is also noteworthy that the drainage system and other features suggest a higher standard of amenity than is found at Ur. In certain 'standard'-like objects, Sir John Marshall sees the possibility of a connexion with Egypt.

THE fifth annual meeting of British zoologists was held on Jan. 7, at the rooms of the Zoological Society, ninety-four zoologists attending, and three guests. Owing to illness of the chairman-elect, Prof. W. Garstang, the chair was taken by the vice-chairman, Dr. G. P. Bidder. Prof. Douglas Laurie and Prof. E. W. MacBride introduced the Report of the Committee appointed to consider the question of animal biology in the school curriculum. All present expressed their conviction that the teaching of animal biology in schools is an urgent necessity. Subject to certain suggestions for the further consideration of the Committee, the Report was adopted unanimously, and the Committee empowered to act for the meeting in making the contents of the Report known and in co-operating with other bodies interested in the subject. For the discussion on "The Scale of Pay of Zoologists," the honorary secretary, Prof. F. Balfour Browne, produced a file of returns of salaries to zoologists at various universities, etc. Dr. Chalmers Mitchell, Prof. Stanley Gardiner, and the honorary secretary were appointed as Committee to examine the material and report to the next annual meeting. In a discussion which followed, all speakers agreed that it is difficult now to induce good men to apply for posts as zoologists in Government service. Although the zoological civil servant requires two more years of education than an administrative civil servant, yet at the age of thirty-five his salary is inferior by 30-50 per cent. It was unanimously resolved: (1) "That this meeting of British zoologists urge on the Government and on Universities the necessity for proper pay and conditions for zoologists in their service." (2) "That the Committee appointed to deal with the returns of posts and salaries of zoologists be asked to advise and suggest as to the steps to be taken to carry out this resolution, and meantime be empowered to act for the meeting."

THE meeting then discussed the Great Barrier Reef Expedition of 1928. Sir Sidney Harmer proposed: "That, in the opinion of this meeting of British zoologists, the investigation of the Great Barrier Reef of Australia is likely to produce valuable additions to knowledge, by elucidating questions of fundamental importance in relation to the growth of coral reefs, and the general biology of marine animals and plants in the tropics; and that progress in this direction will materially assist in the development of the economic resources of Australia." The motion was seconded by Dr. C. M. Yonge, the leader of the Expedition, and carried unanimously. The meeting was informed of the promised co-operation of the Royal Geographical Society, and that, in addition to financial assistance promised by the Australian Barrier Reef Committee, the British Association, and the Zoological Society; the Marine Biological Association has given permission for Mr. F. S. Russell to initiate the plankton researches. Private donors have promised £600. Dr. E. J. Allen and Dr. W. T. Calman then opened a discussion on the present position of binomial nomenclature, and the resolution "That this meeting of British zoologists is in favour of a substantial extension of the lists of *nomina conservanda*," was carried.

THE question of the closer relationship and a better understanding between sheep-breeders and woollen and worsted manufacturers has recently been under consideration by the British Research Association for the Woollen and Worsted Industries, with the view of placing the former in a position of having more precise and definite details of the requirements of the latter. In the determination of the quality of wool, various considerations arise, for example, fineness, diameter, staple length, crimp, etc.; all these must be fully investigated before the manufacturer's requirements can be standardised and the wool-breeder informed exactly what the manufacturer's specifications are. With the view of accelerating the investigations considered by the British Research Association for the Woollen and Worsted Industries, the Empire Marketing Board has granted a capital sum of £7000 as well as an annual contribution of £2000 to the Association for the specific purpose of the study and investigation of wool 'quality.' In order that the whole range of investigation may be complete, a joint programme of research work has been arranged between the Research Association and the Animal Breeding Research Department, University of Edinburgh, to which the Empire Marketing Board is also contributing an additional grant.

THIS grant in no way affects the ordinary work of the British Research Association for the Woollen and Worsted Industries; it is made for a specific problem to be investigated alongside the research work already in hand. In order to carry out the work, sanction has been given for the purchase of additional premises and the creation of new laboratories for biology, biochemistry, colloidal physics, etc., and for the provision of special staff. For the full benefit of the work entrusted to the Association by the Empire Marketing Board to be obtained, additional support for the general programme of research should be forthcoming from the trade itself. In order to encourage this, the Department of Scientific and Industrial Research has agreed to maintain its grant of £4800 for the current year, instead of reducing it to £1200, as would normally have been done. It now remains for the industries themselves to supplement this generous support (based on a careful examination of the work that is being carried out) by increasing their financial interest in this important and vital section of their organisation.

THE annual meeting of the British Ecological Society was held in the New Botanical Department of the University of Birmingham on Jan. 7. Dr. E. J. Salisbury was elected president, Mr. H. Boyd-Watt, vice-president, and the vacancies on the council were filled by Prof. A. E. Boycott and Dr. V. E. L. Anderson. The honorary treasurer in presenting the balance sheet stated that the Society is now in a better financial position than ever before and a further £200 has been invested. The honorary secretary reported that the council has recommended the preparation of a biological flora of Britain which shall contain such information as is available with regard to biological features of ecological significance. A scheme prepared by Dr. Salisbury was approved, and the recommendation of the council that Dr. Salisbury should act as editor was adopted. Mr. Turrill reported that experiments on growing selected plants in various soils have been started at Pottern under the direction of a sub-committee consisting of Dr. A. W. Hill, Prof. Oliver, Dr. Salisbury, Prof. Tansley, and himself. Papers were communicated by Mr. C. S. Elton on "Animal Communities in the Arctic"; by Mr. W. Leach on "The Vegetation of Screes"; by Miss M. K. Bishop on "The Ecological Relationship between Some Species of Juncus"; by Prof. F. W. Oliver on "Early Stages of a Sand-Dune"; by Dr. V. E. L. Anderson on "The Root-Hair in the Soil"; by Dr. W. H. Pearsall on "Michigan Sand-Dunes," and by Prof. Adamson on "The Vegetation of Eastern Rhodesia."

IT is announced by the Colonial Office that platinum has been discovered in Sierra Leone. It was first found in May 1926 by the Director of the Geological Survey, Major N. R. Junner, and a recent investigation by him indicates that the platinum-bearing area is about forty square miles in extent, and that the deposits, which are alluvial, are likely to be of considerable importance. One nugget of platinum weighing 7·4 gm. (4¾ dwt.) was found by Major Junner. This nugget and some of the smaller grains of platinum have been presented to the British Museum (Natural History), South Kensington. An analysis made by the Imperial Institute of the platinum shows that it compares very favourably in composition with the platinum from the Urals and from South Africa. The platinum in Sierra Leone is associated with basic igneous rocks resembling those of the Bush Veld igneous complex of South Africa in which important deposits of platinum metals have been found.

DR. E. SCHRÖDINGER is to lecture in London on wave mechanics at the invitation of the Royal Institution. It has been arranged provisionally that the lectures shall be given on Mar. 5, 7, 12, and 14 at 5.15 P.M. The lectures will be held at the Royal Institution, and will be open to the public.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Chemistry and Industrial Chemistry Department of the Technical College, Cardiff—The Principal, Technical College, Cardiff (Jan. 21). An assistant for technical records work at the Building Research Station, Watford—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Jan. 21). A city analyst under the Leeds Corporation—The Town Clerk, 26 Great George Street, Leeds (Jan. 25). An assistant at the Low Temperature Research Station, Cambridge, for abstracting scientific and technical papers on the preservation and transport of foodstuffs — The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Jan. 26). A graduate to undertake and direct research work at the Glasgow Royal Cancer Hospital—The Secretary, Glasgow Royal Cancer Hospital, 156 St. Vincent Street, Glasgow (Jan. 31). Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (Jan. 31). A professor of civil engineering at the Bengal Engineering College, Sibpur, Bengal—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Feb. 1). A secretary of the Royal Sanitary Institute—The Chairman of Council, Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1 (Feb. 11). A professor of zoology in the University of Manitoba — The Secretary, Board of Governors, University of Manitoba, Winnipeg, Man., Canada. Test assistants at the Royal Aircraft Establishment for work in connexion with the airworthiness approval of aircraft—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 232). A junior lecturer at the Port Elizabeth Technical College, South Africa, qualified to teach elementary mathematics, science, and trade drawings—Box "Z.D. 797," c/o Deacon's Advertising Agency, Fenchurch Avenue, E.C.3. A junior assistant, with museum training in natural history, at the Hancock Museum, Newcastle-upon-Tyne—The Honorary Secretaries.

Research Items.

ARCHÆOLOGICAL DISCOVERIES BY AEROPLANE AT DORCHESTER.—In *Antiquity* for December, Mr. O. G. S. Crawford describes an interesting series of archæological discoveries near Dorchester, in Oxfordshire, due to photographs taken from the air in June last by two officers of the Royal Air Force, Flight-Lieuts. W. E. Purdin and B. T. Hood. The photographs revealed two large circles previously entirely unknown, a rectangular enclosure having no relation to existing field divisions, a semi-circular enclosure, possibly prehistoric, a track, either prehistoric or Romano-British, forty feet wide—an unusual width—traces of several barrows, and a small circle about twenty feet in diameter, consisting of twelve holes which had once been filled with uprights of stone or wood. The two concentric circles first mentioned, it is interesting to note, were partly in two fields, one under barley, the other under beans; but it was only the bean field that showed the circles, of which no trace was to be seen at all at ground level. In order to test the circles and seek evidence of their date, excavations were carried out by Mr. Crawford and Mr. R. G. Collingwood in October. Two trenches were cut, the first of which found the inner circle. At one end of the trench the excavators came on sand at a depth of 2 ft. 6 in. through a deposit of reddish-yellow loam. At the other end, sand was reached at a depth of no less than 6 ft. 4 in. of brick earth, the silt filling up the old ditch. The circle-ditch originally must have been not less than 36 ft. across from lip to lip. The second trench cut the outer circle at the point where the crops divided. Here a layer of 2½ ft. of brick earth covered the sand, and the sides could be seen sloping away from the inner lip. At a depth of 5 ft. 6 in. a foot of black stuff represented the middle of the ditch. Beyond two animal bones and some fragments of bone, no finds were made. The dig, as well as the examination in detail to which Mr. Crawford has subjected the photographs, is a useful demonstration of the value of air photographs, and has thrown much light on what may be termed the technique of their use in archæological discovery.

GOITRE IN SCHOOL CHILDREN.—In the recent issue of the *Annals of Eugenics*, Dr. Percy Stocks is continuing his valuable studies on the influence of iodine in reducing or preventing the incidence of goitre in school children, and in particular of increasing the rate of growth of school girls in height and weight. In collaboration with Miss Mary Karn, he corroborates for large towns in England and Wales the inferences drawn from Swiss and American statistics, that there is a positive relationship between the prevalence of thyroid enlargement in children and cancer mortality.

ICE-DRIFTS AND SEAL-FISHING.—Dr. Thor Ivorson ("Drivis og Selfangst," *Aarsberetning vedk. Norges Fiskerier*, Hefte 1, Bergen, 1927) gives an interesting account of the northern seal fisheries of the ice-drifts with particulars of the biology of the seals and a detailed history of the seal-fishery. The most important seals for the industry are the Greenland or Harp seal *Phoca greenlandica* and the Bladder-nosed seal *Cystophora cristata*, but for the more northern fisheries the walrus *Trichechus rosmarus*, Bearded seal *Erignathus barbatus* and Ringed seal *Phoca fœteda* are of distinct significance. Most of the work refers to the first two species, especially the Greenland seal. Descriptions are given of its breeding places and habits, distribution, and the methods employed in catching it. Both of these seals are truly sea animals and undertake long migrations, keeping in large herds. Their breeding places are the ice-drifts of Jan Mayen, mouth of the White Sea, the Newfoundland ice and the Gulf of St. Lawrence, where the young are born from early February to April. There is a large industry for the young seals, which are left to fend for themselves very early in the case of the Greenland seal and are captured before they are able to swim. The Bladder-nosed seals, both male and female, on the other hand, defend their young, keeping with them for a longer time, and do not fly from the hunters, who shoot down whole families at one time. The questions asked by the writer with regard to the Greenland seal—do the individual seals keep to one breeding-place throughout their life, do all individuals of a group come from a single stock, and, finally, the large question of preservation, are only partially answered and, as he says, much more work is necessary before any answer can be attempted. Researches are needed similar to those already made on the fur seals, which present much less difficulty, breeding as they do in the summer and on land.

A MITE ON A SILKWORM PARASITE.—An interesting account of *Tyroglyphus muscæ*, a mite infesting *Sturmia sericariæ*, a fly noxious to the silkworm, is given by Dr. Chujiro Sasaki (*Journal of the College of Agriculture*, Imperial University of Tokyo, vol. 9, No. 3, Aug. 1927). *Sturmia sericariæ* passes the winter underground as a pupa which is nearly always parasitised by a small mite, *Tyroglyphus muscæ*, a serious pest to the fly. Experiments were undertaken to find out whether the mite attacks the silkworm directly. For this purpose specimens were introduced into vessels containing silkworms in various stages of development, and it was found that the mite invades both pupa and imago, but specially attacks the silkworm at the time of moulting. The silkworm gradually becomes weak and sickly looking and soon dies. The mite attacks various parts of the body of its host, particularly both the thoracic and abdominal legs, which are marked by brownish or blackish patches. Detailed descriptions are given of both the male and female mite and of the life-history, involving four ecdyses with only about twenty-four hours on an average in between the stages. It thrives best in dark and damp places, and can live for two days immersed in water, perishing under dry conditions.

STOMATAL FREQUENCY.—Some interesting facts regarding stomatal distribution in plants from various habitats, but with special reference to woodland forms, have been published by E. J. Salisbury (*Phil. Trans. Roy. Soc.*, Series B, vol. 216, pp. 1-65). Stomatal frequency in the individual leaf shows great variation, being greatest where suction force and osmotic pressure are greatest, although no general relation between stomatal frequency and osmotic pressure is suggested other than a parallel response to the operation of some other factor. Contrary to what traditional interpretations have taught us to expect, Dr. Salisbury finds stomatal frequency to be higher in sun leaves than in shade leaves, and higher in the case of plants grown under xerophytic conditions than in plants from more humid habitats. Comparison between plants grown in dry and moist air respectively indicates that stomatal frequency is mainly dependent on the humidity of the environment. The term 'stomatal index' is used to denote $100 \times S/(E+S)$, where S denotes number of stomata per unit area, and E the

number of epidermal cells in the same area. By means of this index it is shown that the *proportion* of stomata found in the epidermis is no greater in sun leaves than in shade leaves, but there is a higher positive correlation coefficient between the number of stomata and the number of epidermal cells per unit area. The differences are all shown to be due to differences in the growth of the epidermal cells, and the consequent difference in spacing of the stomata. It is claimed that with the exercise of proper precautions as to region of leaf examined and with due regard to its variable character, stomatal frequency has an important ecological significance as an indicator of the humidity of the environment.

CATALASE AND PLANT GROWTH.—The change in the growth of plants in passing from the merely vegetative phase to the reproductive phase is accompanied in the tissues concerned by a corresponding change in the type of metabolism. In *Memoir of the Cornell University Agricultural Experiment Station*, No. 106, J. E. Knott gives numerous data to correlate the catalase activity of the apical bud of spinach with this change in metabolism. When the reproductive phase begins, catalase activity decreases, but the effect seems localised in the one tissue and is only slightly evident in the leaves. Correlated with this decrease in catalase activity, there seems to be a drop in the respiratory rate as determined by the evolution of carbon dioxide. Yet it seems as if new tissue were being formed much more rapidly in the flower stalk than in ordinary vegetative growth. One would expect, therefore, a higher rate of respiration to provide the requisite energy. This increased respiration may be present, and yet not of a type resulting in the evolution of carbon dioxide or associated with catalase formation. In some types of tissue, catalase seems to be related to total respiration. Catalase from apple fruit tissue maintains its maximum activity after the material has been removed to conditions less favourable for its production, and the rapid disappearance of spinach catalase is possibly related to a lower degree of stability. The response of catalase to nitrogen and carbohydrates is interesting. Knott finds that calcium nitrate added to catalase *in vitro* decreases, while asparagin, sucrose, and soluble starch increase activity after 24 hours; *in vivo* the effects of those substances are practically the opposite, the explanation of which is a problem still to be solved. A useful modification of the Bailey hydrogen electrode for measuring the hydrogen ion concentration of liquids which froth readily is described.

PULSATIONS OF THE EARTH'S CRUST.—Part 5 of vol. 2 (Section 2) of the *Jour. Fac. Sci. Imp. Univ., Tokyo*, is devoted to an interesting paper by T. Matuzawa on pulsatory motions in the earth's crust. These were noticed long ago by Milne, but though often studied their nature remains uncertain. G. W. Walker suggested that they are due to Rayleigh waves set up at the sea bottom by water waves, caused by wind, at the surface of the sea. In Japan they are sometimes of considerable magnitude, 0·5 mm. or more, and to these the suggested explanation seems inapplicable. The paper describes the pulsations observed in Japan, and concludes that changes of atmospheric pressure play the most important part in their production. It is suggested that the movements are probably elastic vibrations of some oscillating system proper to the locality of origin.

A CLASSIFICATION OF IGNEOUS ROCKS.—A new quantitative classification of igneous rocks is proposed by E. T. Hodge, and published with a large chart in a University of Oregon Publication (Geology Series, vol. 1, No. 2, 1927). Four 'classes' based on the percentages of felspars plus felspathoids are plotted in four sectors of a circle. Each is divided radially into nineteen 'orders' based on the ratios of orthoclase to other felspars. Finally, the classes and orders are divided (by concentric belts) into seven 'ranges' based on the principle of silica saturation, beginning with quartz rocks on the outside and ending with 'metal' rocks on the inside. Any rock can therefore be placed somewhere in the resulting subdivisions, all of which can be represented on a single sheet. The arrangement is such that the quantitative mineral composition gives approximately the chemical composition. This is expressed on the chart by contour lines of percentages of the chief oxides, and it is claimed that within reasonable limits either chemical or mineral composition will place a given rock in the same pigeon-hole. There is nothing fundamentally new in the scheme proposed except the arrangement, which, however, is ingenious rather than illuminating.

BITUMINOUS SANDS OF ALBERTA.—Part 2 of the Report of the Scientific and Industrial Research Council of Alberta on the famous bituminous sands of that province, by Messrs. K. A. Clark and S. M. Blair, has now appeared, following their earlier publication on the occurrence of these resources. The problem of separation of the bitumen from the sand is not an easy one for large-scale practice, and it has been part of the policy of the Research Council to devote considerable time and money to its solution. This Report is to be read as a summary of progress and, in point of fact, is a valuable résumé of knowledge derived from comprehensive testing and experiment. Bituminous sands of the kind described are valuable both as raw materials and as sources of bitumen. In the latter connexion the chief advantages of separation are that the market available to bitumen is now more extensive than that available to the impregnated sand, and that since the freight charges on the sand are much greater than those on the bitumen alone, an artificial restriction to output is thus created. Furthermore, the manifold uses of free bitumen give to this commodity an advantage over its occurrence in the crude sand-state, in which form it is only suited to the construction of pavements and other wearing surfaces, and then only after special treatment. The authors describe the well-known hot water separation process, but dismiss it in favour of treatment of the sand with hot dilute sodium silicate solution agitated in excess of hot water, from which complete separation of the sand from the bitumen results. This procedure obviously has great practical possibilities, and though it is still in an experimental stage, it would seem as if the problem of asphaltic sands were well on the way to solution at last. The Report gives much detail of both the method and the plant employed in the work, and early industrial developments are foreshadowed.

THE BREADTH OF X-RAY SPECTRA.—There seems now to be little doubt that the great breadth observed in the lines of a number of X-ray spectra is real, in the sense of being atomic, and not instrumental in origin, but its large magnitude, of the order of ten times that to be expected from classical considerations of the damping of vibrations, is the more disconcerting from the fact that the decay of the light from hydrogen positive rays follows the classical laws fairly closely. The factors which might come into play with radiation of high frequency have been reviewed by D. Coster in the *Zeitschrift für Physik* of Nov. 18, where he has considered, amongst other effects, the possibility of an apparently simple line being actually an unresolved multiplet or a species

of band, without, however, coming to any definite conclusion. He has been able to adduce some evidence that the natural breadth arises partly within the atom, and has pointed out a rule which holds for the relatively few lines that have been examined, to the effect that the more eccentric an electron orbit corresponding to a given energy level, the less well defined is a line arising from a transition involving that orbit.

RADIO OBSERVATIONS DURING TOTAL ECLIPSE.—An interesting account of observations made during the total eclipse of June 29 last is given in *L'Onde Électrique* for Sept. 6, by H. S. Jelstrup. A large 'tilting frame' was erected at Nordre Langen in Norway, longitude 11° 51′ east of Greenwich, which was approximately in the centre of the zone of totality. The observations were made on signals emitted from the relay station for Oslo at Hamar, which consequently had to travel an appreciable distance in the overhead 'conducting layer.' The first half of the eclipse was observed in favourable circumstances, but clouds interfered with the later observations. There was a large number of sunspots, and the instants at which these were eclipsed was accurately known. The intensity of the radio signals received from Hamar was read accurately by a micro-ammeter. There was a sudden increase in the ammeter reading at the moment before totality, and this was maintained, with the exception of a few rapid and sudden fluctuations, until after the period of totality. The ammeter gave its maximum reading at the moment after totality. The most obvious explanation is that the increase is merely a night effect produced by the lunar shadow on the conducting layer. The analogy with the effects produced by the setting sun on radio signals is perfect. The mean intensity of the ammeter readings on the day of the eclipse was much greater than on the following day. Whenever the lunar disc covered a sunspot a strong rhythmical disturbance was produced. This was very pronounced when the sunspot was near the centre of the sun's meridian facing the earth. The moon interrupted sharply the radiation proceeding from the sunspot and, after the time required for the radiation to travel from the moon to the earth, produced a disturbance in the waves radiated, and probably therefore in the conducting layer. There are indications that the moon produces a deviation effect on the rays coming from the sun as it approaches it. Hence at the time of the new moon, similar radiophonic effects are probably produced.

CONDUCTIVITY OF MOLTEN GLASS.—It has been known for many years that glass when heated to a temperature above 200° C. is sufficiently fluid to act as an electrolytic resistance. It is known that the passage of the current is due to the motion of the sodium in the glass. Experiments have proved that various metals when used as electrodes migrate into the glass, which thus becomes curiously marked. It is also known to electricians that an excellent arc can be maintained between glass electrodes when the alternating pressure has a sufficiently high frequency. Hitherto, however, very little information has been available with regard to the conductivity of glass when in the molten state. This property of glass is discussed in a paper by F. F. S. Bryson read to the Society of Glass Technology on June 2 last and recently published. He finds that when an electromotive force is applied to suitable electrodes immersed in molten glass, the current which passes through the glass between the electrodes rapidly diminishes for about a minute and then diminishes gradually until the steady state is reached. This is due to a number of bubbles forming in the molten glass next the positive electrode. These bubbles are the products of electrolysis, and as they gather round the electrode they partly insulate it, thus causing the current to fall. By breaking the battery circuit it is easy to measure the back electromotive force due to the polarisation. With alternating currents of ordinary frequencies the polarisation effects are much reduced, but gas bubbles are still formed. When platinum electrodes are used, the passage of the current is accompanied by a continuous succession of minute flashes. In order to diminish the polarisation effects and so enable approximate values of the conductivity at various temperatures to be measured, the author used high frequency currents. Interesting results with various kinds of glass are obtained, the conductivity increasing enormously with the temperature. The results are of importance in practical work as they show a connexion between viscosity and conductivity, and thus indicate the possibility of using recording electrical instruments to measure the viscosity of the molten glass as it flows from the tank.

THE ATOMIC WEIGHT OF ANTIMONY FROM DIFFERENT SOURCES.—The October issue of the *Journal of the Chemical Society* contains a paper by K. R. Krishnaswami, giving the results of a determination of the atomic weights of five samples of antimony. The metal was extracted from stibnite and cervantite from India and Burma and from Kahlbaum's antimony trioxide, as the trichloride, which was converted into the oxide and reduced. Antimony tribromide was then prepared in an atmosphere of nitrogen and the bromide estimated as silver bromide. The results ranged from 121·744 to 121·754 and are in good agreement with those of other workers in recent years. Muzaffar in 1923 obtained values varying from 121·444 to 122·374, using antimony from different sources, but his method appears, according to Krishnaswami, to be more difficult in practice than the one outlined above.

CONSTRUCTION OF DAMS.—In the usual types of dam—arched and otherwise—employed for power or irrigation purposes, provision has to be made for running away the surplus water retained during flood periods and periods of minimum demand, because if the water were simply allowed to run over the sill and fall hundreds of feet below, it would seriously impair the structure of the dam. Hence tunnels, derivation canals, etc., have to be arranged for, often at great expense. To overcome these difficulties, two French engineers, Messrs. Mesnager and Veyrier, have invented and patented a new type of arched dam which is being tried out in the barrage of the Upper Dordogne at Marège. In this type, instead of the direct fall from the sill to the lower level, the fall is split up into sections of 30-50 ft. in height by a number of partitions forming retaining basins which break the force of the water due to the eddying effect set up. These partitions are comparatively thin, and in order to ascertain whether they would stand up to the pressure of the water, experiments were carried out on small-scale models; and, by using mercury as the test liquid, the same effect was obtained as would be caused by the high pressure of water on the walls of the full-scale dam. According to *La Nature* of Dec. 1, in which the experiments are described, the tests have shown that the walls of the dam as actually designed will have a coefficient of safety of from 4 to 5. The experiments are judged of sufficient importance in France to be supported by generous grants from certain Government departments.

Prize Awards of the Paris Academy of Sciences.

AT the annual public meeting of the Paris Academy of Sciences the prizes and grants awarded in 1927 were announced as follows :

Mathematics.—The Francœur Prize to Georges Cerf, for his work on partial differential equations.

Mechanics. — The Montyon Prize to Dimitri Sensaud de Lavaud, for his work on the steering of motor-cars : the Poncelet Prize to Henri Villat, for his works on the mechanics of fluids.

Astronomy.—The Lalande Prize to Vincent Nechville, for his researches on star streams : the Valz Prize to Lucien d'Azambuja, for his work on sun-spots, the solar prominences, and chromosphere : the De Pontécoulant Prize to Emile Paloque, for his work on the analytical theory of the movement of the Trojan planets.

Geography.—The Gay Prize to Henri Humbert, for his work in Madagascar : the Tchihatchef Prize to Jean Delacour and Pierre Jabouille, for their ornithological work in Indo-China.

Navigation.—The prize of six thousand francs between André Courtier (2500 fr.) for his work on hydrographical data and the prediction of tides : Pierre Changeux (2500 fr.) for his general study of the dynamics of ships or apparatus utilised in marine or air navigation : Edouard Davaux, for his "Cours d'electrotechnique" : the Plumey Prize (in equal parts) between Etienne Hugé, for his memoir on the pulverisation and combustion of mazout in marine boilers, and Marcel Gautier, for his memoir on the utilisation of the Diesel motor.

Physics.—The Gaston Planté Prize to Gabriel Foëx, for his work on magnetism : the Hébert Prize to Pierre Sève, for his work on alternating currents : the Henri de Parville Prize to Paul Girault, for his work in electrotechnics : the Hughes Prize to Georges Reboul, for his researches on the radiation of badly conducting bodies through which an electric current is passing : the Pierson-Perrin Prize to Fernand Holweck, for his work on X-rays with wave-lengths between 14 A. and 500 A. : the Clément Félix Prize to Alexandre Dauvillier, to assist him in his researches on X-rays of great wave-length with special reference to their biological properties.

Chemistry.—The Montyon Prize (Unhealthy Trades) to Emile Kohn-Abrest (2500 fr.) for his work on poisonous gases, and an honourable mention (1500 fr.) to Edmond Rolants, for his book, "Les eaux usées" : the Jecker Prize (in equal parts) between Georges Chavannes and André Kling, for the whole of their work : the Cahours Foundation to Clément Duval, for his work on nitrates : the Houzeau Prize to Augustin Damiens, for his work on the existence of bromine in animals and on the phenomena of allotropy.

Mineralogy and Geology.—The Cuvier Prize to Emile Argand, for his work on structural geology, and especially his researches on the Pennine Alps : the Delesse Prize to Charles Jacob, for the whole of his geological work : the Victor Raulin Prize to Fernand Daguin, to assist in the publication of his memoir on the geology of northern Morocco : the Joseph Labbé Prize to André Demay, for his geological work on Pechelbronn petroleum, Carthagena, and Huelva.

Botany.—The Desmazières Prize to V. Likhité, for his book on researches on the development and biology of some Ascomycetes : the Montagne Prize to Adrien Davy de Virville, for his work in experimental morphology relating to the mosses : the de Coincy Prize to Pierre Bugnon, for his botanical work : the Rufz de Lavison Prize to Lucien Plantefol, for his biological study of the moss *Hypnum triquetrum.*

Anatomy and Zoology.—The Da Gama Machado Prize to Henri Neuville, for his work on the skin of the elephant and mammoth : the Savigny Prize to Maurice Langeron, for his pathological researches in Africa, Crete, and the Eastern Mediterranean.

Medicine and Surgery.—Montyon Prizes to Raoul Bensaude (2500 fr.), for his work entitled, "Traité d'endoscopie, rectoscopie, sigmoidoscopie" : to Henri Carré (2500 fr.), for his "Recherches expérimentales sur une ectodermose neurotrope du chien : la maladie des chiens" : to Constantin Levaditi (2500 fr.), for his work entitled "L'herpes et le zona, ectodermoses neurotropes." Honourable mentions (1500 fr.) to Jean Barotte and Achille Urbain, for their memoir "Étude des teignes du cheval et de l'immunité dans les teignes expérimentales" : to Jean Verge, for his experimental researches on a dipthero-variolic affection of birds, and to Christian Zœller, for his researches on diphtheria. A citation to Émile Frache, for his work, "Les fouets et le mouvement des bactéries," and to Gustave Lesbouyries, for his work on the tuberculosis of the domestic carnivora.

The Barbier Prize to André Léri, for his work on affections of the bones and articulations : the Bréant Prize to Charles Dopter and Paulin Vezeaux de Lavergne, for their work on epidemiology : the Godard Prize to René Herpin, for his biological researches on the reproduction and development of some polychætal annelids : the Chaussier Prize to Edmond and Etienne Sergent, for their twenty-five years' work on the study and prophylaxy of paludism in Algiers : the Mège Prize to Félix Ramond, for his book on the diseases of the stomach and duodenum : the Bellion Prize to Jean Rieux, for his work on latent pulmonary tuberculosis ; Grégoire Ichok receives an honourable mention : the Larrey Prize to Jean Jacquemart and Charles Clavelin, for their memoir, the military health service in times of peace and of war : the Argut Prize to André Charles Guillaume, for his work on light radiations in physiology and therapeutics.

Physiology.—The Montyon Prize to Louis Merklen, for his memoir on the rhythm of the heart during muscular activity, especially when due to games : the Pourat Prize to Antoine Magnan, for his work on the mode of flight of birds with application to the construction of aeroplanes : the Philipeaux Prize to Mlle. Eudoxie Bachrach, for the whole of her work in experimental physiology, with an honourable mention to Marc Jacot for his memoir on glycogen, adrenalin, and insulin.

Statistics.—The Montyon Prize to Jean Gérard, for his book on ten years of industrial effort.

History and Philosophy of Science.—The Binoux Prize to Henri Daudin.

Works on Science.—The Henri de Parville Prize to Fernand Monpillard (2000 fr.), for his book, "Macrophotographie et microphotographie," and Mme. Valentine Allorge-Gatin (1000 fr.) for the "Dictionnaire de botanique," by (the late) Ch. L. Gatin.

Medals.—The Berthelot medal to Emile Kohn-Abrest, Clément Duval, and Augustin Damiens.

General Prizes.—The Grand Prize for Physical Sciences to Georges Bohn, for his work in biology and comparative physiology : the Alhumbert Prize to Henri Longchambon, for his researches on triboluminescence : the Lallemand Prize to André Lwoff, for his work on the pigments in Copepods : the Maujean Prize to Raymond Sabouraud, for his work on the cure of ringworm : the Petit d'Ormoy Prize (Mathematical Sciences) to Ernest Vessiot, for the whole of his work : the Petit d'Ormoy Prize (Natural Sciences)

to Lucien Cuénot, for his zoological work: the Le Conte Prize to Alexandre Yersin, for the whole of his work: the Parkin Prize to M. and Mme. Jacques Tréfouel, for their work on certain carbon compounds and their therapeutic action: the Saintour Prize to Stanislas Zaremba, for his work in mathematical analysis: the Lonchampt Prize (in equal parts) between André Liot, for his memoir on the culture of the pyocyanic bacillus in chemically defined media, and Michel Machebœuf, for his researches on the rôle of nickel and cobalt in animals and on the phosphorus compounds of the blood: the Wilde Prize to Jacques Duclaux, for the whole of his work: the Gustave Roux Prize to Jacques Fromaget, for his geological work in Annam: the Thorlet Prize to Adolphe Richard.

Special Foundations.—The Lannelongue Foundation between Mmes. Cusco and Rück: the Hélène Helbronner Prize to Mme. Schrader.

Prizes of the Grandes Écoles.—The Laplace Prize to Marcel Alliot: the L. E. Rivot Prize between Marcel Alliot, André Ligouzat, Raymond Cheradame, and Charles Feyrabend.

Funds for Scientific Research.—The Trémont Foundation to Marcel Jobelot, for his apparatus for the automatic inflation of captive balloons: the Gegner Prize to Francisque Dumont, for his work in geometry: the Hirn Foundation to René Fabre, for his work relating to fluorescence and its applications in analysis and in biology: the Henri Becquerel Foundation to Louis de Broglie, for his work in wave mechanics, atomic structure of matter and radiation: the Charles Bouchard Fund to Gustave Rappin, for his work on cancer and tuberculosis: the Pierre Lafitte Prize to Henri Abraham, for the whole of his work in radio telegraphy: the Roy-Vancouloux Foundation to A. Borrel, for his work on cancer.

Anti-Malarial Measures in Europe.

THE second general report of the Malaria Commission of the League of Nations, recently published, deals with "Principles and Methods of Anti-malarial measures in Europe." The report is divided into three sections. No. 1 gives a summary of the Commission's views on measures for dealing with malaria in Europe; No. 2 is entitled "Arrangements for studying Malaria"; and No. 3, "Prevention and Control of Malaria."

Section 1 is divided into sixteen parts, each followed by a short 'conclusion' of some half-dozen lines or usually less. These conclusions represent the 'average opinion' of the Commission based upon observation and consultation in many European countries. (A map of the study tours is provided.) They have an unexpectedness about them, very soothing to those who have been constantly told but have not entirely believed, that malaria could be, had been, or was being eradicated in all kinds of places and under all kinds of varying conditions from China to Peru, by this or that or the other panacea. Here is the first shock! "When the discovery of the mosquito cycle of the parasite was made, it was almost universally believed that a single simple method had been put within our grasp, capable of application in all malarious districts. Since then nearly three decades have passed, and such a method is still to seek." But the following is still more disturbing. "The history of special 'anti-malarial campaigns' is chiefly a record of exaggerated expectations followed sooner or later by disappointment and abandonment of the work."

Whether we agree completely with these estimates or not, there can scarcely be any doubt in the minds of those who have pondered over the matter, "that the only prospect of real progress lies in the renewed activity in the continuous study of the disease in all its aspects." We well remember the time when it was considered hyper-scientific to urge that anti-mosquito measures should be confined to killing those mosquitoes known to transmit malaria. It was considered to be more 'practical' to destroy all mosquitoes in one great holocaust.

How refreshing the idea that it is not always necessary to deal with malaria by a method arising directly out of the knowledge that the disease is transmitted by mosquitoes, and how sane the advise that "the treatment of malaria-infected persons is one of the most important measures even from the point of view of prevention."

The subject of 'Bonification' is discussed at length. The Italians do not regard large bonifications as an anti-mosquito measure, and they know that such a bonification may increase the abundance of Anopheles in the area reclaimed; but bonification means a better standard of life, and when that is attained, malaria tends, more or less quickly, to lose its importance as a cause of sickness or death. It would take too long to argue here that bonification has been the cause of the disappearance of malaria from England. Bonification, education, is perhaps the fundamental factor in anti-malarial measures. The anti-malarial factor in general schemes of bonification is the change in the conditions of life of the inhabitants. It has been said that "Le remède du paludisme est dans la marmite." It certainly lies in the schools. We welcome this report as a sane corrective to the exaggerated claims that are often made for this or that anti-malarial measure. The third portion of the report discusses various anti-malarial and anti-mosquito measures, such as the use of quinine and larvicides such as Paris green and liquid paraffin.

This second report is as stimulating as the first report issued in 1926. A summary of it by Lieut.-Col. S. P. James will be found in the *British Medical Journal* for Aug. 27, 1927.

Stereoscopic Photographs of Crystal-Structure Models.

A VERY handy little folding stereoscope has been placed on the market by Messrs. Adam Hilger, Ltd., under the name of a 'camerascope,' together with a series of double (stereoscopic) photographs of crystal-structure models, prepared under the direction of Sir William and Prof. W. L. Bragg, to illustrate the more striking and fundamental results of the X-ray analysis of crystals. Both the instrument, when its three hinged parts are folded together (the two outer ones upon the middle basal part), and the forty-one cards on each of which a complementary stereoscopic pair of photographs is printed, fit neatly into a cardboard box so small (5 in. × 4 in. × 1½ in.) as to go conveniently into the coat pocket. As regards the instrument itself, the front plate of the three thin metallic (blackened) parts, which is arranged upright at right angles to the basal part when unfolded, carries the two stereoscopic lenses, and has a hole of suitable shape and size cut out of it to admit the nose; while the corresponding back-plate, also upright when opened out, is the stage and is fitted with suitable grooves and retaining guides for the reception of any one of the picture-cards, which are 4½ in. × 3¼ in. in size.

On placing one of the cards in position, and bringing the instrument so close to the face that the lenses are close to the eyes, one sees the model of some crystal-structure or other, or an instrument (X-ray spectroscope, for example)—whatever it is that is photographed on the card—standing out in the three dimensions of space, as if one were looking at the actual object itself. Users of reading spectacles are recommended, and will find it necessary, to retain them, as no adjustment of the lenses is arranged for, the focus provided being that for normal vision.

Of the forty-one cards supplied, thirty-five are stereoscopic pairs of photographs of models, representing the crystal structure of the more important substances which have been satisfactorily analysed by means of the X-ray spectrometer or spectrograph. Among them are rocksalt, fluorspar, diamond, zinc blende, iron pyrites, spinel, calcite, aragonite, ruby or sapphire, graphite, ice, quartz, barytes, beryl, chrysoberyl, lithium potassium sulphate, cæsium chloride, naphthalene, tartaric acid, and racemic acid. Among the rest are stereoscopic photographs of the Bragg X-ray spectrometer, and of the X-ray spectrograph of Dr. Müller, the latter as arranged in three different ways, for the Debye powder method, the Bragg method, and the Laue and rotating crystal methods.

This use of stereoscopic pictures to represent objects, and in particular models of crystal structure, in relief in the three spatial directions, which is the next best thing to seeing the objects themselves, is not new. Prof. P. von Groth, the veteran crystallographer of Munich, in 1921 issued with his book on crystallography ("Elemente der physikalischen und chemischen Krystallographie") just such a series, twenty-five in number, of stereoscopic picture cards, a little larger than those issued by Messrs. Hilger, packed in convenient pockets on the inside of the front and back covers of the book. These Groth photographs can be used quite well with Messrs. Hilger's little stereoscope, provided the size of the cards be somewhat reduced to fit the stage, by cutting away superfluous margins, the photographs themselves being only very slightly larger than the Hilger ones, to fit a stereoscope of ordinary standard size.

The Hilger instrument is wonderfully effective, and should prove both useful and instructive to all who endeavour to follow the results of X-ray crystal analysis, but have not the immediate opportunity at hand of seeing the actual models or instruments themselves. A. E. H. TUTTON.

University and Educational Intelligence.

HULL.—Mr. T. R. Ferens has given a further sum, of £22,500, to the newly established University College. This brings Mr. Ferens' gifts to the College to about £300,000. He has asked that £20,000 of his latest benefaction should be set aside for endowing a chair.

The foundation stone of the new buildings will be laid on April 28, when the Duke and Duchess of York will visit Hull.

Mr. A. C. Hardy, zoologist to the recent *Discovery* expedition to the Antarctic, will be the first professor of zoology at the University College.

THE first professorship of the geology of fuel (petroleum and coal) at a German technical school has been created at Freiberg in Saxony. The occupant is to be Dr. Otto Stutzer, who has also been elected director of the new fuel institute at the School of Mines.

THE annual report for 1926–27 of the Battersea Polytechnic, of which Mr. G. F. O'Riordan, formerly principal of the Leicester College of Technology, is now principal, shows that the total enrolment during the session was 3019, of whom 449 were full-time students, including 230 (the highest enrolment for many years) in the Training College of Domestic Science Teachers. The number of students preparing for university degrees was 219, and the number of degrees obtained was 37, including two Ph.D. and two M.Sc. degrees. A substantial amount of research work was done by the staff and students.

FROM the Hokkaido Imperial University of Japan we have received a volume published to commemorate the fiftieth anniversary of the founding of the Sapporo Agricultural College in which the University had its origin. The college was established under the guidance of Dr. W. S. Clark, of the Massachusetts State Agricultural College, who came over from America in 1876 for the purpose, and for eight months controlled its administration. For some years the college remained under American tutelage, but by 1893 all foreign guidance had been dispensed with and the professors were all Japanese. The University's indebtedness, however, to the Americans who shaped its beginnings is gratefully recognised, and the memory of Dr. Clark, in particular, is cherished with enthusiasm. It is noteworthy that his influence was strongly tinctured with religion. He introduced the Bible as a medium of literary and ethical instruction, and conducted daily religious exercises. The University comprises now schools of agriculture and forestry, medicine, technology, and fishery; its instructional staff numbers 240, its student enrolment exceeds 2000, its farms cover 15,000 acres, it has 245,000 acres of experimental forest lands, and its budget exceeds three million yen. With the exception of three instructors in English (all from the United States) and two in German, the staff is exclusively Japanese.

IN "Universities in the United States" (University of London Press, price 2*s*.), Dr. Edwin Deller, Academic Registrar of the University of London, describes impressions received in the course of a three-months' tour in the spring of 1926 undertaken by him at the request of the Laura Spelman Rockefeller Memorial trustees. His tour embraced institutions in the east and middle west and in California. His dominant impressions are concerned with the process of popularisation which has been such a marked feature of the recent history of university education in America. The difficulties involved in dealing with the vast multitude of students who come up imperfectly prepared and with no clear objective in mind are, he found, being faced with admirable courage, energy, and resource. He was much struck by the combination of stimulating faith in the universities, with frank recognition of their shortcomings and anxiety to trace these to their sources. He found a general desire to learn from and profit by the experience of other countries. The strongest feature of the American university is the provision for the graduate student. This has already helped to establish the prestige of America in universities in other countries, and promises even greater developments in the near future. In this connexion attention is directed to the tendency observable in some quarters to regard the education of the undergraduate as a task unworthy of the energies of a great university. English experience suggests, Dr. Deller points out, that to bear their best fruit undergraduate and graduate studies flourish best together, but conditions are more favourable in the United States for the experiment of limiting the activities of some universities to graduate work.

Calendar of Customs and Festivals.

January 18.

EPIPHANY AND OTHER OBSERVANCES OF THE GREEK CHURCH.—As the Greek Church retains the Old Style Calendar, Epiphany falls twelve days later than in western Europe. It is a festival held in great regard throughout the Greek Church; but in Rumania the baptism of Jesus Christ is celebrated with special solemnity as one of the most important feasts of the year. It is to be noted that in both ecclesiastical ritual and in popular custom, the observances of this day involve a ceremonial connected with water. In Bukarest, after the Church service a solemn progress, in which the royal family takes part, is made to the River Dambovitza, where, after a service, a gold and enamelled cross is thrown into the river. Men standing by, stripped to the elaborately embroidered shirts which form a characteristic part of the gala national costume, jump into the river, and the one who retrieves the cross receives a present from the king.

In Constantinople a similar procession of dignitaries of the Greek Church goes to "bless the waters of the Bosporus," and a similar religious or semi-religious ceremonial is observed in southern Greece, where it is known as "diving for the cross." Some light is thrown upon the custom when the immersion is involuntary, as in Macedonia, where it is the custom to thrust someone into the water—a river, the sea, or even a pond or well, the victim receiving a reward for his immersion. On emerging from the water he should sprinkle as many of the bystanders as possible with drops of water. The reward is spent on a banquet.

This popular custom suggests a remote origin in a propitiatory offering to the spirit of the waters, while sprinkling the bystanders with the drops of water is in keeping with the belief in the special 'healing efficacy' of the water at this time of the year. Hence also the general desire for baptism at this season. In the Ethiopian Church, all baptisms of the year were reserved for this day. In Rumania, where it is also a specially favoured day for baptism, children baptised at the same time are known as 'brethren of the cross,' and throughout their lives stand in a specially intimate relation one to another. Should one be dying, unless his 'brother' is chained to him and solemnly released by a third person, the 'brother' will also suffer an early death.

EPIPHANY IN MACEDONIA.—Here the twelve days leading up to Epiphany are a period when magical influences are peculiarly potent. On the eve of Epiphany a general cleaning up of the house takes place, and the ashes which have been allowed to accumulate on the hearth are cleared away. With these go the evil influences lurking in the house, and especially the Karkantzari, malicious fiends at night, of human form by day. These beings would appear to be related to the werewolf. No marriages are celebrated while they are about. They may perhaps be credited, therefore, with similar powers to those of the witch who, by 'tying knots,' may cause impotence and render marriage unfavourable at critical seasons.

January 19. (O.S. January 7.)

FEAST OF ST. JOHN THE PRECURSOR AND BAPTIST.—This festival is observed in the Balkans (Macedonia) by a custom analogous to the carnival customs celebrated later in the Ægean. Parties of old men dressed in goat's skin or old clothes, and girt with chains of bells, parade the streets collecting money by terrorising rather than by amusing. Both their attire and the feeling they aim at inspiring would relate them to the awestriking powers of Nature, later symbolised by Pan and his attendants. Milder in form and character are the 'precursors,' each heading a band of eight or ten men, who go from house to house, and are regaled at loaded tables. They then take away everything they have not already consumed in skins and bottles carried for them by boys. In return for their entertainment, the leader improvises highly eulogistic songs on each member of the family.

In Rumania, on the night of Jan. 6 (O.S.), boys obtain from the priest the aspergil, partly composed of basil (a peculiarly 'holy' plant in Balkan belief), used that morning in the Epiphany ceremonial of scattering holy water after the service on bystanders outside the church. They then proceed to visit the houses of the village, and each member of the household is whirled round and round. On the next morning, Jan. 7, they stand at the door of the church and do the same to each one of the congregation, as well as the priest, as they enter. Beyond attributing it to a pagan origin, no explanation has been offered for this custom, but as the solemn canticle of the Epiphany ceremony is sung on entering each house, it is clearly an attempt to extend the sanctifying influence to each member of the community, while the whirling round has all the appearance of a fertility custom.

January 21.

ST. AGNES, ROMAN VIRGIN AND MARTYR, whose chastity was miraculously preserved against all assault, when consigned to the stews of Rome on her refusal to marry the son of the prefect. He, being struck dead for his attempt on her, was restored to life by her prayers. By popular clamour she was condemned to the flames as a witch, but when they refused to consume her she was beheaded on the pyre. Eight days after her martyrdom she appeared to her parents in a company of virgins with a lamb by her side. Hence the lamb is her symbol, and each year in the Basilica to her memory at Rome twin lambs are blessed, and from their wool the pallium of the archbishops is woven.

In view of the history of the saint, it is not surprising that in popular belief her festival, or rather the eve of her festival, should be associated with divination in relation to marriage. Burton, in his "Anatomy of Melancholy," speaks of maids fasting on St. Agnes Eve, and Aubrey gives directions how by sticking pins in a sleeve to the accompaniment of paternosters, a dream of the future partner in marriage may be obtained. The belief was generally prevalent throughout England. A ritual was observed and an invocation addressed to St. Agnes before retiring. Certain precautions had to be observed, such as that no man should kiss the inquirer on that day, and she should wear a clean white shift. In Scotland the custom was that a number of those seeking to know their future husband or wife met at midnight. Each proceeded alone to a certain cornfield, and threw in some grain, repeating a verse invoking the saint. That night the saint granted him or her a vision of the future partner in a mirror.

January 22.

ST. VINCENT'S DAY.—One of the numerous days at about this time of the year associated with weather lore. The return of spring was a matter of special moment to an agricultural or pastoral community. Hence the exhortation to "remember if the sun shine on this day."

Societies and Academies.

CAMBRIDGE.

Philosophical Society, Dec. 5.—**W. H. Mills** and **K. A. C. Elliott**: Molecular dissymmetry dependent on restricted rotation about a single linking. The optically active forms of benzenesulphonyl-8-nitro-1-naphthylglycine. The ordinary criteria which enable the existence of molecular dissymmetry in a compound to be predicted from its structural formula do not indicate that perididerivatives of naphthalene of the type $C_{10}H_6\begin{matrix}NR_1R_2\\NO_2\end{matrix}$ should be obtainable in enantiomorphous modifications. It has proved possible to demonstrate experimentally that this type of dissymmetry actually exists in the benzenesulphonyl derivative of 8-nitro-1-naphthylglycine.—**F. G. Mann**: Note on the configuration of the tetrammino-platinous complex. The uniplanar configuration was first allotted to the tetrammino-platinous complex by Werner in order to explain the existence of two forms of dichlorodiammino-platinum $[Cl_2Pt(NH_3)_2]$. Reihlen and Nestle, however, consider these two forms to be not isomeric but polymeric, and assign the tetrahedral configuration to the platinous complex. It seems highly probable that certain complex platinous salts have the tetrahedral configuration, and that the configuration of any particular complex salt is determined mainly by the nature of the co-ordinating groups.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Nov. 4.—**P. O. Pedersen**: Composition, pressure, temperature, and electrical conductivity of the air at high altitudes in the light of radio-wave propagation.

Nov. 18.—**Niels Bohr**: The quantum postulate and the recent development of atomic theory. The dualism which characterises the formulation of the quantum theory has received much illumination through the recent great progress of atomic theory. In the present state of science, this dualism would seem unavoidable and may be regarded as a direct expression of the fundamental limitation of the ordinary principles of classical physics postulated by the quantum theory.

Dec. 2.—**Johs. Lindhard**: The elasticity of skeletal muscles. Experiments show that the coefficient of elasticity decreases when the muscle is stimulated.

GENEVA.

Society of Physics and Natural History, Nov. 3.—**R. Wavre**: The heterogeneous fluid mass in rotation and geodesy. The author demonstrates that Stokes's theorem relating to the Newtonian potential of a heterogeneous fluid mass in relative equilibrium $U_{ext} = F(S,\ \omega = c,\ M)$ can be extended to all cases where the angular velocity is a function of the distance from the axis, that is to say, to any planet of which the layers of equal density are horizontal at each point.—**W. H. Schopfer**: Physico-chemical researches on some parasites of fresh- and salt-water fishes. The experiments show that the parasites studied have a Δ very near that of the intestinal liquid of their host and also of that of the internal medium of the latter.—**L. Duparc, E. Molly, and A. Borloz**: Birbirite, a new rock. The authors have found in Abyssinia and in Serbia a quartz rock containing on the average 90 per cent. of silica, composed of grains of quartz, sometimes spherolitic, covered with a mass formed of quartz grains and isotropic material.—**M. Gysin and L. Duparc**: The phenomena of magmatic and secondary Uralitisation. The gabbro diorites of the northern Ural show a magmatic transformation of pyroxene into brown hornblende and a secondary transformation of the latter into a blue amphibole.—**A. Schidlof**: The geometrical representation of the mass of a material point in a universe of five dimensions. The author indicates a geometrical interpretation of the great difference which exists between the mass of the proton and that of the electron.—**Raoul Pictet**: Experimental demonstration of the potential of the ether. Its consequences in the physical theory of the properties of vapours and gases. The author completes the account of the subject given in the meeting of Oct. 20.

Nov. 17.—**G. Tiercy**: A new method for determining the form of the light curve of a variable star. The author measures on a photographic plate the lengths of the spectra and the widths of the lines. These two magnitudes are connected by a simple relation which allows of the construction of the light curve of a variable star.—**A. Brun**: The augite and chrysolite of Stromboli. The augites of Stromboli lend themselves to crystallographic measurements if the surface is cleaned by immersing for some seconds in hydrofluoric acid. They contain as inclusions chrysolites of small dimensions not permitting of exact measurement.—**A. Brun**: Change of the parameters of magmatic augite. If the edge (011) ($0\bar{1}1$) is taken for the axis of x, y and z remaining the same, the law of Bravais is completely verified (the law connecting the frequency of the faces and their reticular density).—**Gr. Gutzeit**: A colour reaction of the vitasterins. A suitable solution of antimony trichloride and hydroxylamine hydrochloride allows a colorimetric estimation of the vitasterins and appears to permit of a separate estimation of the A and D factors.—**L. Duparc and E. Molly**: An Abyssinian augitite. This rock contains augite and magnetite as phenocrystals in a vitreous mass with grains of magnetite and microlites of augite. It contains 42 per cent. of silica.—**E. Briner and A. Van der Wijk**: The effect of moisture on the peroxidation of oxide of nitrogen. Experiments made with the reactions ammonia and hydrochloric acid, hydrogen and chlorine, oxide of nitrogen and chlorine, propylene and bromine, appear to show that the action of moisture is especially exerted in the formation of heteropolar compounds.—**R. Wavre**: A useful formula for geodesy. Supposing, in a fluid star in permanent movement of rotation, layers of equal density normal at each point to the field of gravity, the mean curvature of the surface at a point can be determined by means of the formula

$$\frac{dg}{dn} = Cg + \Delta Q - 4\pi\epsilon\rho.$$

—**R. Pictet**: A gas cycle transforming into energy the whole of the heat furnished to the cycle. According to the author, it should be possible to realise with the aid of a gas a cycle furnishing the total transformation of the heat utilised into mechanical work.

ROME.

Royal National Academy of the Lincei. Communications received during the vacation.—**A. L. Herrera**: Thermotropism and constants of the colpoids. Like mobile cells and microscopic organisms, colpoids exhibit positive thermotropism, this effect being due to increase in the osmosis, and to increased intensity of the currents on the membrane and of the chemical reactions on the heated side. Moreover, as regards their movements, colpoids are subject to minimum, maximum, and optimum temperatures.

The presence of lactose increases the osmotic pressure and determines the formation of enormous colpoids, which have the shape of horse-shoes and imbibe at their extremities.—**L. Petri**: Further investigations on the application of fluoroscopic analysis to normal and pathogenic vegetable tissues. Contrary to the indications of earlier experiments, the alcoholic extract of chlorophyll, carotin, and xanthophyll obtained from leaves killed by boiling water, always contains part of the photo-luminescent ingredient. The properties of this substance show that it must be placed among the glucosides.—**R. Caccioppoli**: Quadrature of plane and curved surfaces.—**G. Supino**: Influence of perforations on the elasticity of a plate.—**V. Ronchi**: Distortion: a new interpretation of an old experiment.—**F. Ruda**: Explanation of the 'green ray.' Julius has explained the observed long duration of the so-called green ray, in comparison with the theoretical duration, by assuming that, in the neighbourhood of the horizon, the atmosphere exhibits anomalous dispersion of the sun's light for the waves comprised between Fraunhofer's lines E (526·97 $\mu\mu$) and F (486·06 $\mu\mu$). A consequence of this assumption would be a sensible difference between the index of refraction of air devoid of, or poor in, ions and that of air rich in ions. The author's experiments fail to reveal any such difference.—**M. L. Pagliarulo**: Further researches on natural rotatory and refractive dispersion. The rotatory dispersion of monoisoamyl aspartate is distinctly anomalous and of the same type as that of monoethyl aspartate. Between the rotatory and refractive dispersions there exists a close relationship, which is not evident from the dispersion curves themselves, but is made manifest by calculating the finite differences of the indices for successive wave-length intervals and representing these graphically.—**G. Mezzadroli** and **G. Gardano**: The formation of formaldehyde and sugars by the action of ultra-violet rays on alkali and alkaline-earth bicarbonates. These bicarbonates are decomposed by ultra-violet rays with velocities which are greatest for the calcium, and least for the sodium salt. The amount of aldehyde obtained is greater from ammonium bicarbonate than from the alkali bicarbonates, but the greatest yield of formaldehyde is furnished by calcium bicarbonate.—**L. Fernandes**: Investigations on sulpho-salts. (4) Certain derivatives of a hypothetical thioacquic acid. Various methods of preparation are available for obtaining parasulphomolybdates of the form $[H_2(MoS_4)_6]^{R'_5}_{H_5}$ which are the sulphur analogues of the paramolybdates. The ammonium compound decomposes readily, but is stable in the presence of ammonia.—**B. Monterosso**: Preliminary observations on the biology of the genus Scytodes (Walck) (Areneæ veræ, Sicariidæ).—**A. Busacca**: Histological changes encountered in the naphthalene cataract when the crystalline fibres are examined in a surviving condition. The first alterations in the crystalline fibres with animals to which naphthalene has been administered orally are intra-cytoplasmic and consist in the disappearance of the more refractive droplets in the cytoplasm of the more peripheral fibres. These droplets increase in number until they occupy the whole fibre, the chondroma at the same time breaking up and disappearing. The changes afterwards extend to the inner fibres.—**G. Testi Dragone**: Contribution to the study of the fluorescence of chlorochrome in ultra-violet rays. When exposed to the influence of ultra-violet rays, chlorochrome exhibits a red fluorescence of various gradations. This fluorescence is obtained *in vitro* only when the chlorochrome is in solution, but it is visible in the living chloroplasts.

Official Publications Received.

BRITISH.

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1926-27. Pp. 14. (Leeds.)

Quarterly Journal of the Royal Meteorological Society. Vol. 53, No. 224, October. Pp. 327-467. (London: Edward Stanford, Ltd.) 7*s.* 6*d.*

Journal of the Manchester Geological Association. Edited by Laurance H. Tonks. Vol. 1, Part 1, 1925-6. Pp. 62. (Manchester.) 7*s.* 6*d.*

FOREIGN.

Smithsonian Institution: United States National Museum. Bulletin 100, Vol. 6, Part 4: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. Report on the Echinoidea collected by the United States Fisheries Steamer *Albatross* during the Philippine Expedition, 1907-1910. Part 1: The Cidaridae. By Theodor Mortensen. Pp. iii+243-312+plates 48-80. (Washington, D.C.: Government Printing Office.) 45 cents.

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 134: Geodetic Operations in the United States, January 1, 1924, to December 31, 1926. (Report to the Section of Geodesy of the International Geodetic and Geophysical Union, International Research Council.) By William Bowie. Pp. iii+34. (Washington, D.C.: Government Printing Office.)

CATALOGUES, ETC.

Calendar for 1928. (London: British Museum (Natural History).)

Calendar for 1928. (London: *The Chemical Trade Journal and Chemical Engineer.*)

Calendar for 1928. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Diary of Societies.

SATURDAY, JANUARY 14.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.—Dr. C. S. Myers: The Influence of the Menstrual Cycle on Muscular and Mental Efficiency. (An investigation carried out on behalf of the Industrial Fatigue Research Board by S. C. M. Sowton and Dr. C. S. Myers.)—J. W. Cox: Mechanical Aptitude: Its Existence and Measurement.

INSTITUTION OF MECHANICAL ENGINEERS (Bristol Branch) (at Bristol).—Prof. C. J. Hawkes: The Marine Oil-Engine (Thomas Lowe Gray Lecture).

MONDAY, JANUARY 16.

VICTORIA INSTITUTE (at Central Hall, Westminster), at 4.30.—Dr. W. Bell Dawson: The New Testament Era in the Sequence of Prophecy.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—G. M. Lees: The Physical Geography of South-East Arabia.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: A Review of Hunter's Experiments of Growth and Grafting, and the Interpretation of his Results in the Light of Modern Discoveries.

RAILWAY CLUB (at 25 Tothill Street, S.W.), at 7.30.—Lieut.-Col. W. R. Mansfield: Timetables, Old and New.

ROYAL SOCIETY OF ARTS, at 8.—Dr. A. E. Dunstan: The Scientific Foundation of the Refining of Petroleum (Cantor Lecture) (I.).

CHEMICAL INDUSTRY CLUB, at 8.—J. Hill: The City Churches.

HUNTERIAN SOCIETY, at 9.—Dr. H. Kelly: Emergent Gynæcology (Hunterian Lecture).

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.15.—Dr. Jane Walker: Saints, Medicine, and Surgery.

INSTITUTION OF THE RUBBER INDUSTRY (Sales Section) (at Engineers' Club, Coventry Street).—C. Tullberg: Art of Window Dressing.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—J. Stewart: Malting Barleys of 1927.

UNIVERSITY OF BIRMINGHAM CHEMICAL SOCIETY (at Birmingham University).—Prof. W. N. Haworth: Presidential Address.

TUESDAY, JANUARY 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—P. R. Coursey: The Development of Dielectrics for Electrical Condensers (I.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at City Hall, Leicester), at 6.45.—A. H. Law and J. P. Chittenden: Higher Steam Pressures and their Application to the Steam Turbine.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Dr. C. H. Lander: The Fuel Problem.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Dr. T. Slater Price: A Résumé of Recent Work on the Effect of Adsorbed Ions on the Photo-sensitivity of the Silver Halides.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering Club, Wolverhampton), at 7.30.—E. A. Watson: The Electrical Characteristics of Spark Gap and Sparking Plugs.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—J. Pryde: Vitamins and Diet.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch), at 7.30.—J. Calderwood: Diesel Engine Drive for Generators and other Auxiliary Machinery on Board Ship.

HULL CHEMICAL AND ENGINEERING SOCIETY (at Photographic Society's Rooms, Grey Street, Hull), at 7.45.—F. H. Peck: Hydro-electric Development in Brazil.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Dr. C. D. Broad: Main Problems of Ethics.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. R. R. Gates: Amerindian Crosses in Canada.

INSTITUTE OF BREWING (Scottish Section) (at Caledonian Station Hotel, Edinburgh).—C. Ranken and J. R. Bell: Surface of Yeast as a Factor in Fermentation.

MINERALOGICAL SOCIETY.—Dr. L. J. Spencer: Potarite, a New Mineral discovered by the late Sir John Harrison in British Guiana.—Dr. H. V. Ellsworth: A Simple and Accurate Constant-Volume Pyknometer for Specific Gravity Determination.—W. Campbell Smith: The Optical Orientation of Labradorite from County Down (Ireland) determined by the Federov Method.

WEDNESDAY, JANUARY 18.

SOCIETY OF GLASS TECHNOLOGY (at College of Technology, Manchester), at 2.30.—W. W. Warren: The Design and Operation of Glass Furnaces.—P. Marson (based on a Paper by Prof. W. E. S. Turner): The Manufacture and Use of Glasshouse Pots.—Prof. W. E. S. Turner: The Refining of Glass.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Growth of Living Tissues under Experimental Conditions and the Bearing of the Knowledge thus obtained on Abnormal Growth of the Human Body.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—Eng.-Capt. E. C. Smith: Some Episodes in Early Ocean Steam Navigation.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—H. A. Reed: Appliances for Handling Goods in Ports and Docks (Vernon-Harcourt Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—W. Ellerd-Styles: Large Electric Baking Ovens.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—W. T. Griffiths: Some Interesting Properties of Alloys of Nickel.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—G. E. Taylor: Electric Furnaces in Metallurgy.

MANCHESTER GEOGRAPHICAL SOCIETY (at 16 St. Mary's Parsonage, Manchester), at 7.30.—L. M. Butterworth: The Lancashire Glass Industry (Lecture).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting, at 7.40.—Presentation of Symons Medal to Prof. H. Hergesell.—Prof. H. Hergesell: The Observation of Clouds with Special Reference to The Safety of Aviation.—Sir Gilbert T. Walker: World Weather.

MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30.—Rev. C. E. Y. Kendall: The Paper Aquatic Molluscs.

ROYAL MICROSCOPICAL SOCIETY (Annual Meeting), at 8.—Dr. J. A. Murray: Staining and Structure (Presidential Address).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. M. Fletcher: Architecture of Provincial France (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—A. H. Barker: Methods of Radiant Heating.

ENTOMOLOGICAL SOCIETY (Annual Meeting), at 8.

FOLK-LORE SOCIETY (at University College), at 8.—Mrs. F. Ayscough: A Calendar of Chinese Household Customs.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—W. James: Polishing and Plating.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—E. S. Horning and A. H. K. Petrie: Enzymatic Function of Mitochondria in the Germination of Cereals.—S. Dickinson: Experiments on the Physiology and Genetics of the Smut Fungi.—P. H. H. Gray: Formation of Indigotin from Indol by Soil Bacteria.—Dr. R. A. Fisher: Triplet Children in Great Britain and Ireland.—Prof. J. W. H. Harrison: (*a*) A Further Induction of Melanism in the Lepidopterous Insect, *Selenia bilunaria* Esp. and its Inheritance; (*b*) Induced Changes in the Pigmentation of the Pupæ of the Butterfly, *Pieris napi* L. and their Inheritance.—*To be read in title only*:—J. Piiper: On the Evolution of the Vertebral Column in Birds illustrated by its Development in Struthio and Larus.—F. G. Gregory and A. S. Horne: A Quantitative Study of the Course of Fungal Invasion of the Apple Fruit and its Bearing on the Nature of Disease Resistance. Parts I. and II.—F. G. Gregory: The Differential Effect of the Ions of Three salt Solutions on the Growth of Potato Plants in Sand Culture.—Sir Kenneth Goadby: Bacterial Proteins.—L. Rapkine and R. Wurmser: On Intracellular Oxidation-Reduction Potential.—Dr. F. W. R. Brambell: Development and Morphology of the Gonads of the Mouse. Part II.—Prof. R. C. Punnett: Linkage Groups and Chromosome Number in Lathyrus.

LINNEAN SOCIETY OF LONDON, at 5.—C. V. B. Marquand: On Capt. Kingdon Ward's Botanical Collections from the Eastern Himalaya and Tibet, 1924–25.—F. W. Edwards: Insect Collecting in the Southern Andes.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. F. Thorpe: The Significance of Unsaturation in Carbon Compounds (I.).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. Ellerd-Styles: Large Electric Baking Ovens.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Major W. S. Tucker: The Problem of Noise in Civil Aircraft and Possibilities of its Elimination.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—T. Smith: On Toric Lenses and Canonical Forms in the Theory of Asymmetrical Optical Systems.—Dr. M. Herzberger: Some Remarks on an Extension of the Optical Cosine Law.—Tintometer, Ltd.: Demonstration of the Rosenheim-Schuster Colorimeter.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—T. H. Turner: Heat Resisting Alloys.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry, East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—Discussion on The Separation of Solids and Fluids.

CHEMICAL SOCIETY, at 8.—Prof. G. T. Morgan and H. Burgess: *cyclo*-Telluropentane.—I. Vogel: Syntheses of Cyclic Compounds. Part II. Racemic and Meso Ethyl $\beta\gamma$-diphenylbutane-$\alpha\alpha\delta\delta$-tetracarboxylate. Synthesis of a Truxinic Acid.—E. H. Farmer, C. D. Lawrence, and Prof. J. F. Thorpe: Properties of Conjugated Compounds. Part IV. The Formation of Isomeric Additive Dibromides from Butadiene.

LANCASTER ASTRONOMICAL AND SCIENTIFIC ASSOCIATION (at Storey Institute, Lancaster), at 8.—G. Dixon: Coal Gas Manufacture.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Chandos Street, W.), at 8.15.—Surg.-Commdr. D. H. C. Given: Some Health Problems of the Singapore Naval Base.

EUGENICS SOCIETY (at Royal Society), at 8.30.—F. C. Bartlett and others: Discussion on Innate Qualities in Social Classes.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Informal Discussion.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—L. H. Fry: Some Experimental Results from a Three-Cylinder Compound Locomotive.

FRIDAY, JANUARY 20.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—M. G. Simpson: The Indo-European Telegraph Department.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Meeting) (in Botany Department, Imperial College of Science), at 5.—Presidential Address.

SOCIETY OF MEDICAL OFFICERS OF HEALTH (at 1 Upper Montague Street, W.C.), at 5.—Dr. W. Elliot and Prof. R. H. A. Plimmer: Recent Advances in the Knowledge of Food.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: A Summary of the Evidence, both Experimental and Clinical, of the Growth-controlling Functions of the Pituitary Gland.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—G. Fairrie: The Production and Refining of Cane Sugar.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Fifth Report of the Steam-Nozzles Research Committee.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Dr. R. C. Fox: The Three Cathode Carbon Arc.

WEST CUMBERLAND SOCIETY OF CHEMISTS AND ENGINEERS (at Workington), at 7.—O. T. Jones: The Lubrication of the Automobile.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group Informal Meeting), at 7.—T. H. B. Scott: The Pictorial Aspect of Modern Buildings.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—S. Hopkins: Steam Accumulators.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (jointly with Society of Dyers and Colourists (Manchester Section)) (at Milton Hall, Manchester), at 7.30.—Dr. A. E. Everest and J. A. Wallbrook: Azoic and other Insoluble Colours.

TUBERCULOSIS SOCIETY (at Royal Society of Medicine), at 8.—Dr. G. Jessel, Dr. A. P. Ford, Miss Lewis, and others: Discussion on the Work and Aims of Tuberculosis Care Committee and Kindred Agencies.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Prof. S. Russ, Dr. T. F. Cotton, Dr. Justina Wilson, and others: Discussion on Diathermy in Relation to Circulatory Disturbances, particularly in High Blood Pressure, etc.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Photo-electricity.

SOCIETY OF DYERS AND COLOURISTS' (Scottish Section) (at Glasgow).

SATURDAY, JANUARY 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Some Tudor Biographers (I.).

PHYSIOLOGICAL SOCIETY (in Department of Physiology, King's College).

PUBLIC LECTURES.

FRIDAY, JANUARY 13.

UNIVERSITY COLLEGE, at 5.—C. F. A. Pantin: Comparative Physiology. (Succeeding Lectures on Jan. 20 and 27, Feb. 3, 10, 17, and 24, Mar. 2, 9, and 16.)

MONDAY, JANUARY 16.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—R. L. Cornell: Poultry Diseases.

TUESDAY, JANUARY 17.

KING'S COLLEGE, at 5.—Dr. J. A. Hewitt: Integration in the Nervous System. (Succeeding Lectures on Jan. 24 and 31, Feb. 7, 14, 21, and 28, Mar. 6.)

WEDNESDAY, JANUARY 18.

UNIVERSITY COLLEGE, at 4.—Prof. A. V. Hill: Muscle. (Succeeding Lectures on Jan. 25, Feb. 1, 8, 15, and 22.)

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30—Dr. R. Burrows: The Medical Practitioner in relation to the Administration of Justice.

THURSDAY, JANUARY 19.

UNIVERSITY COLLEGE, at 5.—Dr. R. J. Ludford: Cytology in Relation to Physiological Processes. (Succeeding Lectures on Jan. 26, Feb. 2, 9, 16, and 23.)

KING'S COLLEGE, at 5.30.—Dr. F. W. R. Brambell: The Development of Sex, with special reference to Recent Work on Birds and Amphibians. (Succeeding Lectures on Jan. 26, Feb. 2, 9, 16, and Mar. 1.)

SATURDAY, JANUARY 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Stone working in Ancient Egypt.