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Pure Chemistry: a Report and its Implications.

FROM time to time in these columns the necessity for a new orientation of educational thought has been stressed. We have pointed to the changing intricacy of modern life—quickened, illuminated, ennobled, and enriched by the practical application of many sciences—and have frankly stated the view that, unless the new aspects and forces be deliberately woven into our educational schemes, those schemes are foredoomed to failure.

It is our business, however, sedulously to avoid being carried away by any theory which will not submit to all possible tests. All the many facets which a single problem may present must be taken into consideration. We do not imagine, for example, that one successful experiment necessarily presents a sound reason for sweeping and immediate alterations to some industrial process which rests upon conditions not always apparent in the laboratory.

Such considerations compel us to realise that the educational changes we have in mind cannot be made impetuously. Time is necessary for the formation of professional no less than public opinion. Environmental factors need adaptation. If, for example, we have urged greater attention to technical education, not only as a *sine qua non* of industry but also as a vehicle of liberal qualities as yet but dimly apprehended, we have not failed to observe that its success is as much dependent upon its relationships with other forms of education and with industry as it is upon administrative method and teaching power. Is there any proof that advance in these directions is being made?

An encouraging answer is to be found in a Report[1] concerning the provision of chemical instruction in technical institutions, recently issued by the Board of Education. We congratulate the compilers on a brief and excellent piece of work. In the sober and guarded language of an official report, they have done something more than sketch out the volume and character of the provision of instruction in pure chemistry in English technical schools; they have done something more than set out important statistics and comment on the general standard of the work. They have shown clearly the influence of factors upon which we have frequently insisted. They have presented undeniable evidence of definite advance as a result of those factors; and, in spite of their assertion

[1] Report of H.M. Inspectors on the Provision of Instruction in Pure Chemistry in the Technical Colleges and Schools in England. Pp. 11. (London: H.M. Stationery Office, 1927.) 3*d*. net.

that only pure chemistry is under review, they have, by implication, described the way of further development in other subjects.

Notice the result of wider secondary education (in the full meaning of the term) and the growing appreciation of employers of the instruction available. It is now expected that, before admission to a full-time course, a student should have received a secondary school education, though matriculation is not essential: students entering part-time courses need not have been through the ordinary secondary school, but are expected either to have passed through a junior technical course consisting of mathematics, science, drawing, and English, or to show they have some knowledge of these subjects. This improvement is not due solely to the wider provision of varying types of secondary education, but also to "the growing practice of employers in requiring that candidates for junior positions in their laboratories shall have received a superior type of education."

Well-organised evening courses, too, are playing a part which is of especial importance when it is noted that, of the 11,000 students taking instruction in pure chemistry, only about 15 per cent. are in full-time attendance (at 32 institutions). In 163 institutions, however, instruction is provided in part-time grouped courses. Insistence is now possible on an adequate standard of training preliminary to admission to evening junior technical courses. "As a consequence a higher standard of attainment is now secured in respect of an increasing number of part-time students."

Active interest on the part of employers and better preliminary training cannot, however, produce this higher standard of attainment unless administrative and co-ordinating factors also receive attention. By no means small have been the parts played by examination arrangements. "In the north-west the influence of the Union of Lancashire and Cheshire Institutes has been operative; in the midlands and the south the attraction of a University degree has been more important . . . in Pharmaceutical courses, the new requirements of the Pharmaceutical Society have increased both the numbers of students and the systematic character of their studies." This question of examinations—a vital function in the educational process—is, in its wide implications, still under discussion in connexion with most branches of technical education, and there can be no doubt that the National Certificate schemes have gone far to satisfy supporters of the purely internal and of the purely external systems. Nor have examinations and new requirements fallen with dead and levelling weight upon the institutions: "This degree of organisation has been secured without depriving the schools of their individuality."

If any more definite measurement of all-round improvement be necessary, the following extract can scarcely be bettered: "A few years ago the proportion of students attending courses was probably not half what it is now. The standard of admission was lower and less clearly defined, and a large number of students were entering upon the study of applied Chemistry with totally inadequate grounding in Pure Chemistry and with no previous or concurrent instruction in Physics." Now nearly eighty per cent. of part-time students take courses involving attendance on three evenings per week and including the subsidiary subjects of mathematics and physics. There is also a growing tendency to prepare for the associateship of the Institute of Chemistry in both full- and part-time courses.

Though, however, the organisation may be excellent, the success of the work must ultimately rest upon the teacher—the final executive officer. In this connexion again the Report is soberly confident. The main work is in the hands of the permanent teachers of the technical school, who are assisted in the evening work by teachers who are employed in the day time in Secondary, Junior Technical or Central Schools, or in industry. A very large proportion of both groups possess graduate or equivalent qualifications. "The general standard is therefore high, and is almost in itself a guarantee of the fullness and accuracy of the instruction." Some points of criticism arise, however, which give an indication of the special qualities which are needed in technical teaching—qualities not always found in teachers trained along the usual academic lines. "Some teachers who have had experience with young students cover the ground too slowly for the older students who attend evening classes, and they waste a good deal of time endeavouring to elicit conclusions from early and isolated experiments." The use of text-books, too, is not always understood. "Students need to be trained to acquire information for themselves, and the lecture hour is often more profitably devoted to emphasising important points—*creating perspective* [our italics]—than in conveying information which can be obtained quite easily from a book."

A broad classification of 10,379 students following part-time courses is given. Within the chemical industry 2450 are engaged in laboratory

work; 1309 in the factory, and 651 in clerical or commercial work. 2324 are engaged in retail pharmacy and dispensing, while 3645 are absorbed by "other occupations." These figures give peculiar significance to another valuable point to which the Report directs attention. In some schools "insufficient training is given in the simple laboratory operations. The students have not enough practice in fitting up apparatus, and the importance of neatness and tidiness is not sufficiently impressed upon them." We have already noted a not dissimilar criticism in a speech made to the Association of Teachers in Technical Institutions by the ex-president of the Society of Chemical Industry (NATURE, June 25, p. 942).

We hope in observing these defects we do not give any wrong impression. We asked, at the outset, whether any proof was available concerning our own expressed views on the new factors which are slowly to change much current educational theory. The Report provides us with adequate proof, and we shall bear its principles in mind in reviewing subjects other than chemistry. In the meantime, so far as the latter is concerned, the crisp conclusion of the Report stands in need of no adornment. "The teachers as a body are well qualified and generally competent; the accommodation and equipment are, on the whole, good; the organisation of most of the courses is satisfactory; and the defects to which attention has been drawn are the exception rather than the rule."

X-Rays and Contemporary Physics.

(1) *X-Rays and Electrons: an Outline of Recent X-Ray Theory.* By Prof. Arthur H. Compton. Pp. xv + 403. (London: Macmillan and Co., Ltd., 1927.) 25*s*. net.

(2) *Introduction to Contemporary Physics.* By Dr. Karl K. Darrow. Pp. xxvi + 456. (London: Macmillan and Co., Ltd., 1927.) 25*s*. net.

(1) THE rivalry of classical wave theory and modernist quantum theory has of late years dominated the physics of radiation, and in spite of all our efforts we can scarcely say that a really satisfactory solution is yet in sight. Nowhere is the conflict more acute than in the field of X-rays, and the investigations of the past few years have all gone to emphasise the differences rather than to reconcile the warring interests. On one hand we have the establishment of what might be called the optical properties of X-rays, such as reflection at a glass surface and refraction through a prism, phenomena hitherto always explained in terms of the wave theory: on the other hand, quantum effects of an extreme type have been revealed by the study of the extraordinary effect known by the name of Compton, who first established that for very short X-rays, where the quantum of energy is large, the radiation can be shown to behave in many respects like a minute projectile, the results of whose impacts with an electron can be calculated on the lines of the impacts of massive spheres. Prof. Compton has also been closely interested in many problems which have been worked out in terms of the wave theory, such as the questions of the intensity of X-ray reflection and of X-ray absorption. His recent book on X-rays and electrons has therefore strong claims on our attention.

Prof. Compton's book is, broadly speaking, devoted to the discussion of experiments and theories bearing on the physical nature of X-rays, and comparatively little is said of their applications either to the study of crystal structure or to practical questions such as the investigation of fibrous forms, organic or metallic. Much of the first part of the book is devoted to physical problems of which an explanation can be attempted in terms of classical electromagnetic theory, such as the polarisation of scattered X-rays, the intensity of X-rays reflected from crystals, and the more strictly optical properties of X-rays. Within the last few years, X-rays have been diffracted by ruled gratings, chiefly by Compton and Doan, and by Thibaud, and a striking photograph is given of a spectrum so obtained. Of course, the accuracy to be expected with this method does not so far approach that obtainable with ordinary crystal methods, but a value for the wave-length of molybdenum $K\alpha$ has been obtained which agrees exactly with the crystal determination.

A special chapter is devoted to the refraction, in the ordinary optical sense, of X-rays, and the small deviation from Bragg's law $n\lambda = 2d \sin \theta$, which has been experimentally detected, is explained in terms of the refractive index, which calculation shows to be slightly less than unity. The total reflection at small glancing angles to be expected from such a value of the index, and the refraction by a prism of glass established by Siegbahn and others, are illustrated by excellent photographs. As Compton emphasises, the experimental determination of the refractive index affords a straightforward method of determining the total number of extranuclear electrons, and the value so found

agrees closely with the atomic number. As is natural, the book contains full references to recent American work, such as Hewlett's repetition of Barkla's work on the scattering of soft X-rays which, on the basis of J. J. Thomson's classical theory, also gives very satisfactory values for the number of electrons in, for example, the carbon atom.

The questions of the intensity of reflection of X-rays from crystals and the closely allied questions of absorption are treated in much greater detail than has so far been attempted in any book in English. The well-known work of W. L. Bragg and his collaborators, and the theoretical treatment of the whole problem by C. G. Darwin, are discussed at some length, and recent work by the author and his collaborators and other American workers, which is not yet widely known, is described. Prof. Compton has devoted much research to this part of the subject, and the various aspects of the somewhat complicated phenomenon of primary and secondary extinction come up for treatment. The distribution of electrons obtained by W. L. Bragg and by the later American workers depends, of course, upon the laws of classical electrodynamics, and it is not established beyond doubt that they form a valid basis for such calculation.

The inability of the classical theory to explain the scattering of hard X-rays is well known, and Prof. Compton's account of his discovery of quantum scattering and the researches which have followed it, especially in America, will be eagerly read. The quantum theory of the change of wave-length which accompanies the scattering of hard X-rays by 'free' electrons is very simple, and the general features—change of wave-length with angle of scattering, directed scattered quantum and recoil electrons—have been clearly confirmed by experiment. In this field the Wilson cloud chamber has proved its value as an instrument of investigation in a number of daring experiments. When we try to go a little farther, however, the initial simplicity is quickly succeeded by complications and difficulties. The calculation of the broadening of the unmodified line demands some hypothesis as to the behaviour of the electrons within the atom, that is, we have to take into account the orbital motion of the electron at the moment when it is 'struck' by the quantum of radiation, and Jauncey's calculation on these lines is only partially satisfactory. The intensity of the scattered X-rays takes us still farther into doubtful and difficult fields. Here we may hope for the new quantum mechanics, out of which the Compton effect comes so naturally, to give us some acceptable solution.

The points mentioned are chosen from among some of the most interesting, and do not exhaust the scope of the book. There is, for example, a chapter on familiar lines dealing with X-rays and crystal structure, and another dealing with the elegant and less-known method of treating diffraction by a crystal from the quantum point of view.

The treatment in the book is largely mathematical, and greater attention is paid to the theories than to the description of experiments: for example, the account of Compton and Simons' striking cloud experiment on the direction of the scattered quantum is very meagre, and less clear than the short description given by Kallmann and Mark in *Ergebnisse der Naturwissenschaften*. Naturally, the work of American investigators receives great prominence, to the relative exclusion of German work. The work of the last few years is really the subject of the book, so that it often happens that partially unsolved problems and incomplete investigations are treated at great length. This actuality of the book will enhance its value to all those engaged in research in these difficult regions, but sometimes renders it tough reading.

The general production is excellent, but it is unfortunate that the proof-reading has not been more carefully carried out. The literal misprints are many, but need not trouble the reader, as it requires, for example, little ingenuity to see in *Naturious* a reference to *Naturwissenschaften*, or to see that by Iλ is meant I_λ. When it comes, however, to being referred back to Fig. 4.05 and finding that it means Fig. 45; to page ix. 23, and having to discover that it means page 280 in chapter ix.; to page 22 when page 241 is meant, and so on, the reader grudges the waste of time. The index is incomplete even beyond the worst of indexes, and may give a false idea of the scope of the book: for example, the names of Dirac, Kuhlenkampff, Ishino, and many other workers do not occur in it, although there are references to their work in the book. These blemishes, however, are minor defects, which should not damp our appreciation of a book in which a great investigator gives an account of some of the most striking recent investigations in physics, of which he himself has been a great part.

(2) The reports on contemporary advances in physics, published by Dr. Darrow in the *Bell System Technical Journal*, and distributed in separate form, are known to many physicists:

Dr. Darrow, who is a member of the staff of the Bell Telephone Laboratories, has now brought out a book based on them. The "Contemporary Physics" of the title refers to what may be called the physics of atoms and rays, and no attempt is made to cover the whole field of physics. Within the range chosen, Dr. Darrow has made an excellent selection of material, which includes much important American work not hitherto quoted in text-books. The disconnected nature of the original articles, each of which referred to some one topical branch of investigation, has not been entirely eliminated in the book, so that we find some overlapping, and an order which must sometimes prove disconcerting to the student. Thus ionisation and radiation potentials are discussed in Chapter vii., while elastic and inelastic impact are first defined in a subsequent chapter, and an account of Bohr's atom model is given still later. The final chapter, which follows the epilogue, is a practically independent dissertation on the conduction of electricity through gases. The separate chapters make very interesting reading, for the author has picked out for treatment the phenomena on which attention is chiefly concentrated at the present time, and the book is embellished by a number of pertinent photographs illustrating various features of modern work on spectra, which are not, however, very clearly reproduced in some cases.

Dr. Darrow's book, like Prof. Compton's, serves to remind us of the enormous amount of purely scientific work now being carried on in great laboratories of America, both those of universities and those attached to great commercial concerns. E. N. DA C. A.

Yield Trials in Agriculture.

The Principles and Practice of Yield Trials. By F. L. Engledow and G. Udny Yule. Pp. 78. (London: The Empire Cotton Growing Corporation, 1926.) 2*s*.

IT is now nearly twenty years since a considerable number of agronomists in Great Britian have reached the opinion that agricultural field trials, whether concerned primarily with manures or with varieties, if they were to afford practical guidance to the farmer, must be carried out with increased precision. The important preliminary work of exploring the variability of yield by *uniformity* trials was performed for England in two excellent investigations by Wood and Stratton at Cambridge and by Mercer and Hall at Rothamsted. At about the same time, by what is not necessarily a coincidence, a fundamental advance in the theory of errors, which renders possible the exact treatment of the evidence of small samples, was made by that anonymous genius who disguises his identity under the pseudonym of "Student." Since that time the work of applying the knowledge gained to the practical refinement of agricultural experimentation has been actively carried on by Dr. Beaven at Warminster, and more recently in the Statistical and Field Department at Rothamsted; it would scarcely be an exaggeration to regard "Student" as the spiritual father of both developments.

The recent memoir by F. L. Engledow and G. Udny Yule on the "Principles and Practice of Yield Trials" represents another case of the co-operation between the statistical and the experimental phases of the same large problem. It is divided into two sections, of which the first includes an explanation of the statistical methods advocated, while the second deals with "practical considerations and procedure." Commencing with Mercer and Hall's data in their uniformity trial with wheat, the reader receives a clear explanation of why an experiment, comparing the yields of single half-acre plots, may be expected to yield errors of the order of 5 per cent.; and of how much higher accuracy is attained by utilising the same area under smaller replicated plots. A statistical treatment is given for replicated plots, and a table of the normal distribution is provided and its use explained for finding the probability of exceeding by chance a given multiple of the standard error as estimated. Theoretical and practical limitations of the formula are then discussed, the principal of the latter being that ascribed to the differential response of varieties to climatic variations.

In the second portion we do not hear so much of "practical considerations" as we might have hoped from the title, for the authors devote most of the available space, as they naïvely say, "to explain broad questions of policy," so that we are left much in the dark as to their opinions on many practical details. Only variety trials are discussed, and these only with cereals. The treatment is less systematic than that of the first part, and we are seldom allowed to forget, for more than a few paragraphs, how comparatively unimportant the author considers yield trials in general, and in particular the improvements in accuracy of which they are susceptible. It is difficult to summarise this section. The first three portions seem designed to assert, at some length, that (i) varietal differences in quality are often more important than yield; (ii) qualitative differences should govern

the choice of varieties for yield trials; (iii) the significance of yield-trial results is limited by their not being performed by industrial farm methods.

The fourth, fifth, and seventh portions are devoted to observation plots, an important subject, upon which the author speaks with authority, but which unfortunately can scarcely provide a preliminary opinion as to yield, much less a measure of it. Yield trials on the plan denoted 'chessboard' are most carefully described; it should be noted that the author limits this extremely vague term to small trials carried out under a wire cage, with individual seeds dibbled at regular intervals, on a fine tilth; the 'plots' are about a yard square. The reader of this portion will realise the force of the strictures previously developed upon the limited agricultural significance of trials, which depart from the methods of practical farming, but will wonder why no distinction was there made between 'chessboard' trials of this type and the better-known methods of plot replication in the open field. A second valuable portion is the description of Beaven's half-drill strip method. Unfortunately, this is the only field method discussed. The last two portions on the size and arrangements of plots, and on 'corrections' for soil irregularities, have perhaps been hurriedly written, and without any very full consideration of the subject.

The authors have missed the fact that the method developed, following "Student," in Section I., is equivalent to a method of 'corrections' stigmatised on p. 75; as, indeed, is necessarily any method of eliminating a portion of the soil heterogeneity. The fact also, that "Student" had shown eighteen years before that precise values of the probability may be obtained in tests of significance with small samples, is overlooked on p. 77, where it is asserted that "in agricultural work with a very small sample (*e.g.* of four or five observations) *the value of P, however obtained, is quite untrustworthy.*" This criticism should of course be confined to the methods here expounded; the great beauty of "Student's" treatment lies in the fact that it does give trustworthy tests of significance, within the scope of agricultural experimentation.

Apart from this omission, statistical criticisms will naturally be few. It appears unfortunate that in developing "Student's" method of treatment of a replicated experiment, the estimation of residual errors has been changed in such a way as to produce, in some cases, a serious under-estimate. A point, which is likely to be in some ways more misleading, lies in the use on p. 30 of the standard error appropriate to a pair of varieties chosen at random, to test successive differences of a number of varieties set out in order of yield. This procedure is often grossly misleading, since the best and worst of a set of random yields from the same variety will often show 'significant' differences if tested in this way.

The curiously pessimistic tone as to the value of yield trials which influences both sections of the book is perhaps to be ascribed to a somewhat unexpected limitation of outlook as to the scientific purposes which such trials serve. After giving reasons for thinking that the differential response of varieties grown in different years may be so much as 5 per cent., a figure which the reviewer does not consider exaggerated, the authors continue (p. 33):

"In view of such results, it may well be asked, what is the value of these elaborate tests? The answer, though it may seem pessimistic to some, must be, we think, that it is very little or, if the phrase is preferred, extremely limited. Even in so far as the investigator is concerned with yield alone—and usually he is equally concerned with other qualities—he is concerned with the *average relative yields* over successive years."

It does not seem to have occurred to either author that a knowledge of these differential responses to weather or soil would itself be of extreme agricultural importance in the practical choice of varieties; and that such knowledge would do much to remove the real grievance of innumerable farmers who grow, for example, wheat in the west, or turnips in the south, of England, far from the centres of the industry, where research is properly concentrated. On the contrary, both effects are looked upon merely as 'errors' to be averaged out by interminable repetition. This same consideration of differential weather responses evidently also underlies the numerous passages decrying attempts to increase accuracy.

To adduce the importance of qualitative differences as a reason for neglecting accurate yield trials appears to the writer at least equally far-fetched. After all, the demand for higher yielding varieties comes straight from the practical farmer, and, however difficult the experimenter may find it to attain adequate accuracy to meet this demand, it is a mere evasion of the difficulty to discant upon the importance, which no one denies, of qualitative differences. How the practical adviser is to weigh qualitative advantages against a loss of yield, or vice versa, without an *accurate* knowledge of the yield factor, is nowhere explained.

For these weaknesses it is probable that neither author would be to blame had the book been published either earlier or later by a few years; a few years ago, the theory on which the Latin Square

and other ' randomised ' systems are based had not been developed, and in a few years' time the lessons learnt from their use, whether more or less favourable to these methods, will be sufficiently well known, even to writers without personal experience of their working. At the moment they are in the difficult position of judging of the newer developments in experimental theory and technique, by the standards of an older theory and technique, the defects and inconsistencies of which it is the avowed purpose of the newer methods to correct. It is the paradox of the present situation that cotton growers overseas should be putting into practice the applications of just these newer theoretical developments, which their academic mentors would have them regard as impracticable.

R. A. FISHER.

Physical Chemistry and Geological Problems.

Physico-Chemical Geology. By Dr. R. H. Rastall. Pp. vii + 248. (London: Edward Arnold and Co., 1927.) 15*s*. net.

IN recent years the empirical descriptive methods of an older generation of petrologists have been fortified by exact experimental work in fields of high temperatures and pressures; and some knowledge of the more notable results that have been achieved, and of the fundamental principles of physical chemistry on which they are based, has now become an indispensable part of the equipment of a modern petrologist. The steady stream of publications from the Geophysical Laboratory at Washington, and from various European workers such as Vogt and Niggli, indicates the increasing importance of chemical thermodynamics in revealing the processes which rocks have undergone. Hitherto, however, there has not been in English any systematic introduction to physical chemistry in its application to geological problems. Dr. Rastall will earn the gratitude of a wide range of students by providing this excellent foundation for more extensive studies.

The first four chapters deal with the basal conceptions of equilibrium and the phase rule, and with the phenomena of fusion and solidification, solution and crystallisation, isomorphism and polymorphism. The principles having been clearly established and illustrated by cogent mineralogical examples, the author passes on to their application to igneous rocks. These are polycomponent systems, so complex that a satisfactory phase rule discussion is generally out of the question. Nevertheless, the ternary systems embraced in the group of components SiO_2—MgO—CaO—Al_2O_3, and the systems albite-anorthite, diopside-plagioclase, and orthoclase-silica, all of which have been worked out fairly completely under anhydrous conditions, have made it possible to consider some of the simpler magmas and their cooling histories with very successful results.

Little is known as yet of the quantitative effects of volatile fluxes, though preliminary work in simple cases with water and carbon dioxide as the volatiles has already encouraged the geophysical workers at Washington to more ambitious attempts to conquer this difficult field. It is probably here that the most brilliant conquests will ultimately be made, for already Th. Vogt has shown that the pneumatolytic and hydrothermal stages in the cooling of a magma can be explained on physico-chemical grounds. Moreover, increasing attention is now being given to the separation and transfer of gaseous phases as an active process in causing differentiation, facilitating assimilation, promoting metasomatism and concentrating ores. These topics are still largely confined to more or less speculative discussions of field observations, and, perhaps rightly in an elementary book, Dr. Rastall has touched on them but sparingly. His discussion of differentiation, however, clearly shows that, despite the work of Brögger, Harker, Bowen and many others, the mystery of the general problem still remains to be solved. Dr. Rastall puts his finger on the core of the difficulty when he writes: " There is no experimental evidence at all in support of the theory that a silicate melt tends to split into two conjugate solutions. Nevertheless many of the facts of Nature indicate pretty clearly that something of the sort does occur."

It is suggested that there is no justification for the recognition of the *spilitic* suite of rocks on the ground that its members differ from the ' true alkaline rocks ' only in having soda in considerable excess of potash. But they appear in a totally different structural environment from typical alkaline rocks, and if Shand's clean-cut definition of the latter be accepted, then most spilites are not technically *alkaline* at all. The recognition of a *spilitic* suite should not be described as an attempt to confuse the issue (p. 95); rather, it is an attempt to clarify an issue that is at present excessively confused.

The integration of processes described as metamorphism is next treated. Here many mineral associations are clearly deducible from the phase rule; but where differential pressure has operated,

the natural conditions again rapidly pass out of the present scope of experimentation. Thermodynamic principles lead to the important deduction that differential pressure lowers the melting point. This curious fact, so remarkable to the beginner, has endless applications, and it is a disappointment to find it merely stated without a graphical demonstration.

Weathering is very properly separated from metamorphism, for its processes involve the reactions of aqueous solutions in an environment of low pressure and fluctuating but relatively low temperatures. Despite the apparent simplicity, the conditions are tantalisingly complex from the point of view of physical chemistry. The peculiar properties of surfaces, capillary spaces, and colloids (the last briefly treated in the final chapter) all require fuller investigation, and still further complication is introduced by the uncertain influence of bacterial activity.

Little reference is made to the conditions that control the cementation of sediments and the growth of concretions. This is a subject that has been strangely neglected, and a systematic treatment in a book of this kind would be widely appreciated. The precipitation of saline deposits from surface waters is, on the other hand, a subject that has been thoroughly tidied up, thanks to the familiar investigations made by Van 't Hoff and his colleagues. The results are briefly reviewed in a chapter on salt deposits, in which is also included an account of the origin, still vaguely understood, of the carbonate formations, including dolomite. The two remaining chapters are devoted to ore deposits and refractories and abrasives, branches of economic geology on which Dr. Rastall speaks with the personal authority of a wide experience.

Dr. Rastall has skilfully avoided the tempting atmosphere of speculation. He has surveyed his subject with commendable restraint, and produced a clearly written and trustworthy book which reveals both the strength and the limitations of the methods of physical chemistry. To know that the natural interplay of energies in the earth is too complex for complete imitation is a mental tonic rather than a cause for depression. To know that laterite, dolomite, lamprophyres, and many another puzzling rock still present baffling problems to be solved, merely adds to their fascination; and when all is said, one feels, after considering the subject matter of this book, that Sederholm is thoroughly justified in his insistence that geology is very much more than applied physics and chemistry.

ARTHUR HOLMES.

Biological Philosophy.

Theoretical Biology. By J. von Uexküll. Translated by Dr. D. L. Mackinnon. (International Library of Psychology, Philosophy, and Scientific Method.) Pp. xvi + 362. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 18*s*. net.

THE publishers of the International Library of Psychology, Philosophy, and Scientific Method are to be congratulated not only on the inclusion in their collection of this peculiarly interesting addition to biological thought, but also on securing the services of such an able translator. Reference to Dr. D. L. Mackinnon's name on the title-page is necessary before the fact of translation is realised.

In this "Theoretical Biology," von Uexküll discusses modern biological concepts, and summarises them in relation to his extended application of Kantian philosophy to the animal world. Biological science has come to a deadlock by having been too greatly dominated by the physicist's insistence on an objective world, whereas the true secret of understanding is to be found not behind objects but subjects. The observer's viewpoint must of necessity be outside this subjective world, and when this fact is clearly realised, investigation can proceed.

The mechanical processes of the organism reveal a conformation to a rule of Nature, which is not merely a mechanical law, but also indicates that there is a super-mechanical factor at work. With the production of a new framework, a process which takes place within every cell, repair proceeds from within. In a machine, this need for reconstruction must be dealt with from without, therefore here is an example of this super-mechanical factor, or 'impulse,' as von Uexküll calls it. Invasion of a cell by impulses is always followed by the formation of a new framework, and consequently the impulses are referable to an influence exerted by the genes on the protoplasm. These impulse-systems are not regarded as a 'psychical world-factor'—on the contrary, von Uexküll anticipates their isolation, since already there are indications that transference of form-giving impulses can take place. Thus they are part of an "objective conformity with plan," a biological doctrine into which "Lamarckism would pass straight over, would it but throw off its psychological wrappings." There is no question of 'purpose' or 'purposefulness,' as is generally understood by the idea of 'conformity with plan.' von Uexküll deplores the fact that the personification of Nature, which conception has

occupied the minds of men for so long, cannot be dismissed once and for all from the realms of biological thought, and with it the inability to recognise "limits to the possibility of knowledge," so that full attention can be given to the acquisition of those positive additions to knowledge by means of which alone real progress can be made. H. E. B.

Enzymes.

Enzymes: Properties, Distribution, Methods and Applications. By Prof. Selman A. Waksman and Prof. Wilburt C. Davison. Pp. xii + 364. (London: Baillière, Tindall and Cox, 1926.) 25*s.* net.

THE authors of this book state that it has been their endeavour to collect in as concise a form as possible the available information in regard to enzymes and to indicate the original sources from which more detailed knowledge may be obtained. To piece these irregular and loosely fitting fragments together has been their object. Special attention has, they say, been paid to the occurrence and preparation of enzymes, to the methods of the measurement of their activity, and to the practical application of these agents.

The text is divided into four sections, each of which is subdivided into chapters as follows: (*a*) Properties of enzymes (four chapters); (*b*) distribution of enzymes (three chapters); (*c*) methods for the preparation and study of enzymes (seven chapters); (*d*) practical application of enzyme activity (one chapter).

There is a bibliography giving references to 1323 original papers, none of which, however, is later than 1925. The book is brought to a close with an index.

The introductory chapter gives an outline of the history, general characteristics, nomenclature and classification of enzymes. The next three chapters deal with chemistry, biology, and physics. The major portion of the next chapter is devoted to the occurrence and distribution of enzymes in animal secretions and tissues. This is followed by two shorter chapters on the enzymes of the higher plants and of micro-organisms.

The section commencing with Chapter viii. is the longest in the book, covering as it does 128 pages of text. Although containing some most useful information, clearly set forth and well arranged, it is here that we venture to make some criticism. Under methods of measuring diastatic action, the authors describe Wohlgemuth's iodine method and Lintner's saccharometric method. In regard to the latter, a modification is described which is more complicated and does not appear to lead to increased accuracy. No mention is made of the titration method devised by Prof. A. R. Ling, which has been adopted by the Institute of Brewing as one of the standard methods of malt analysis. Nor is there any mention that when the activity of malt diastase is measured by a saccharometric method, the production of reducing sugar must be kept within the limits laid down by Kjeldahl in 1879 if the results obtained with two or more samples are to stand in direct proportion.

In dealing with the synthetic action of enzymes, the work of Bourquelot—by far the most important on the subject—is not alluded to in the text. In that part of the book dealing with desmolases—oxidases, oxido-reductases, and zymases—sometimes the difference between supposed direct oxidase action and dehydrase action is described in a manner likely to prove misleading to the student. The authors make no reference to the discovery by Hopkins in 1921 of an autoxidisable constituent of the cell which he named glutathione, although they *do* refer to the significance in respiration of substances containing the thiol group SH which is present in reduced glutathione. Another serious omission is that of a reference to the recent work of Robison on the part played by calcium hexosephosphate and its enzyme on ossification and dentition.

If there are defects in the preceding parts of this book, there are more pronounced cases in the last chapter which deals with the uses of enzymes. Barley is said to absorb 40-50 per cent. of its weight of water in the steeping process—the first in the conversion of barley into malt. The fact is that barley after steeping contains about 50 per cent. of water. In describing the mashing process the temperatures given are 23°-13° C. too low for distillery practice and 26°-16° C. too low for brewery practice. The subject matter on the hydrolysis of starch by enzymes given in the book is out-of-date, as is also that dealing with the estimation of starch by enzymes, and the latest methods adopted in England find no mention. These are only a few of the defects which could be cited.

We close our review with a feeling of disappointment. Some portions of the book are such as to recommend it, whilst others show that the authors have omitted important observations or have failed to understand the true significance of some points to which they have referred. It is hoped that a new edition will be published in the near future in which the entire work will be recast, for the authors have not attained the objects which they set themselves to achieve.

Our Bookshelf.

Practical Coal Production. Mine Transportation and Market Preparation: Mine Transportation, Hoisting and Hoisting Equipment, Coal Preparation. Compiled by Frank H. Kneeland. Pp. vii+354. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 15*s.* net.

THIS volume is the third of the series of "Practical Coal Production" and may be looked upon as a continuation of the two previous ones, which have already been discussed in these columns. The present volume is no advance on its predecessors, showing quite as strongly as they do the defects previously indicated, and being perhaps even more 'scrappy' than either of the others. It contains three chapters, on mine transportation, hoisting and hoisting equipment, and coal preparation respectively. The first part consists of a miscellaneous collection of information concerning animal and locomotive transport underground; perhaps the best point about this section is the considerable attention paid to underground track work, the importance of which is just beginning to be recognised by colliery managers. Chapter ii. is almost wholly taken up by calculations, such important matters as the construction and design of cages and headgears not being even mentioned. Having regard to the recent developments in American coal mining, one would have expected to have found some information, at any rate, as to the employment of skips instead of cages, but this again has been entirely neglected. The third chapter is taken up mainly with coal conveying and screening. The author is aware of coal washing, but he dismisses it in a few lines, as though it were not in fact the most important part of coal preparation at the present day.

The author's lack of knowledge of what has been done in Great Britain again makes itself manifest at various points; thus he describes as an entirely novel invention screens, which he calls weight-vibrated, being evidently unaware that the appliance he is describing is simply the old Beaumont vibromotor invented years ago in England. Whilst the book is well got up, misprints are more numerous than they should be. Perhaps the most noteworthy one is a caption on p. 3, "Insulting the Mule," when it is obvious from the context that the author must have written "Insulating."

(1) *Proceedings of the London Mathematical Society.* Second Series. Vol. 25. Pp. 546. n.p.
(2) *Journal of the London Mathematical Society.* Vol. 1. Pp. 272. n.p.
(London: Francis Hodgson, 1926.)

THE London Mathematical Society now issues its transactions in two volumes a year, the *Proceedings* and the *Journal*. Vol. 25 of the *Proceedings* contains 31 technical papers on various branches of mathematics read before the Society between March 1924 and January 1926. The high standard of recent issues is fully maintained, among the more notable contents of this volume being Mr. Chaundy's "Poncelet's Poristic Polygons," Prof. Landau's "Zum Waringsche Problem," and Prof. Turnbull's "Invariant Theory of Mixed Quaternary Forms." Only a small number of papers deal with geometrical matters, an indication that most of the mathematical research now done in England is analytical rather than geometrical in character. Our only criticism is of the length of time, sometimes more than a year, which elapses between the reading of a paper and its appearance in the *Proceedings*.

Instead of the abstracts which have appeared in recent volumes of the *Proceedings*, the Society now issues a *Journal*, of which the first volume is before us. It contains records of the meetings held in the session 1925–6, three lectures given at meetings, and about fifty notes and short papers. Prof. Baker also contributes obituary notices of F. Klein and C. Segre, both being worthy tributes to the memory of distinguished mathematicians. Of the lectures, Dr. Glaisher's on the early history of the Society is the one of most interest to a general reader. Many of the short papers contain significant contributions to mathematical knowledge, Mr. Grace's "Point in Enumerative Geometry," Prof. Hobson's "Generalisation of a Theorem due to Riesz," and Prof. E. A. Milne's "Diffusion of Imprisoned Radiation through a Gas" being typical of many others showing marked progress in their respective fields. The publication of this new *Journal* has been rendered possible by the increased membership of the Society and also by the greater volume of noteworthy mathematical research produced in recent years. Either *Journal* or *Proceedings* can be obtained in parts as issued by non-members of the Society. W. E. H. B.

L'Atomisme d'Épicure. Par Dr. Xénia Atanassiévitch. Pp. 111. (Paris: Les Presses universitaires de France, n.d.) n.p.

DR. ATANASSIÉVITCH has written an interesting and well-documented study of the atomic theory of Epicurus, in which he maintains that, far from being a mere expounder of the theory of Leucippus and Democritus, Epicurus was responsible for the introduction of many new features. The number of fragments of Epicurus accessible to us is very limited, consisting mainly of a few letters, preserved for us by Diogenes Laertius, of which the authenticity is not established beyond doubt, but fortunately we possess what is probably a very faithful account of his theories in Lucretius' "De Rerum Natura." Leucippus, who is a mere name to us, and Democritus, whose work is also lost to us, supposed, according to their expounders, that atoms were indestructible and eternal, infinite in form and in number, and that everything arose from the collision of atoms in empty space. Epicurus denied that the atoms could have an infinite variety of forms, which agrees with our modern belief, and insisted that atoms had weight, which, according to Dr. Atanassiévitch, was a property foreign to the atoms of Democritus. For Epicurus, then, atoms had size, shape, weight, and

velocity. Very interesting, in view of our modern theories, is the Epicurean doctrine, stressed by our present author, that, although atoms are physically indivisible, they have finite extension, and are to be considered as made up of small ultimate parts, *minima*. A chapter is consecrated to this doctrine of the minimum.

It is very strange that, without any given experimental basis, often with ridiculous arguments —as when he cites spontaneous generation as a proof that atoms have no sensations—Epicurus should have arrived at a conception of the atom so similar in its essence to our present-day atoms built up of electrons. It would seem that there is something inherently attractive for the human mind not only in an atomic theory, but also in an atomic theory of a particular kind. Dr. Atanassiévitch's little book is well worthy of study by all interested in the history of scientific theories.

E. N. DA C. A.

Among the Kara-Korum Glaciers in 1925. By Jenny Visser-Hooft. With contributions by Ph. C. Visser. Pp. xii + 303 + 25 plates. (London: Edward Arnold and Co., 1926.) 21*s.* net.

KARA-KORUM is the name of a pass, yet it has been applied not only to the range containing the pass, but also to a tangled mass of mountains lying far to the west. Exploration of this tangle has indicated that it consists of a series of ranges; so that the name Kara-Korum, as it is generally used, indicates a large district, rather than any particular range of mountains.

The area explored by Mr. and Mrs. Visser was limited to the headwaters of the Hunza River. The only way into most of the valleys lay through narrow gorges, occupied by rivers which were subject to sudden floods; so that the line of retreat was often closed for long periods. The party were actually imprisoned in this way in the Khunjirab valley, and were only saved from starvation by forcing their way over unknown glaciers and passes into the Shingshal valley. The glaciers in these valleys are unusually treacherous owing to the rapid melting of the ice under the tropical sun. Snow avalanches are common, but the greatest danger is caused by avalanches of stones. One such avalanche in the Hispar valley lasted for many hours, and filled the air with dust, producing the effect of a thick London fog.

The party successfully explored some of the largest glaciers in the world; the Batura glacier—37 miles of ice—and the chief glaciers in the Khunjirab and Shingshal valleys. The area traversed was mapped by Afraz. Gul Khan Sahib, whose services were lent by the Survey of India. Mrs. Visser, who makes little of her own exploits, crossed glaciers and passes the existence of which was unknown even to the natives of the district. Two Swiss guides accompanied the explorers, and to their expert knowledge of ice, and its habits, the expedition probably owed its escape from the hourly dangers due to floods and avalanches.

This book is illustrated by some excellent photographs.

The Scientific Feeding of Animals. By Prof. O. Kellner. Authorised translation by Dr. William Goodwin. Second edition, revised. Pp. xiii + 328. (London: Gerald Duckworth and Co., Ltd., 1926.) 8*s.* 6*d.* net.

THE name of Kellner figures pre-eminently in the annals of the science of animal nutrition. Towards the end of the last century, at a time when little or no attention was being devoted in Great Britain to the elucidation of the scientific principles underlying the economic feeding of farm animals, Kellner was carrying out in Germany a series of classical researches which had the ultimate effect of raising the art of feeding to the level of a science. Indeed, the rapid progress which has been made in Great Britain during the last three decades in the development and application of the principles of feeding is, in large measure, a tribute to the excellence of Kellner's pioneer work.

Many students of animal nutrition science have had reason to feel grateful to Dr. Goodwin for the enthusiasm and initiative which led him, during the early years of the present century, to undertake the translation of Kellner's smaller text-book, "Grundzüge der Fütterungslehre." For many years this work stood unrivalled as a source of information to student, investigator, and farmer alike. The welcome appearance of a new English edition has afforded Dr. Goodwin the opportunity of including the additional matter contained in the latest German edition, which has been revised and brought up-to-date by Prof. Fingerling, who succeeded Kellner at Möckern. In particular, a new chapter on vitamins has been added. Despite these alterations, however, the book still remains, to quote Prof. Fingerling, "a masterpiece of clearness and precision." H. E. WOODMAN.

True Irish Ghost Stories. Compiled by Dr. St. John D. Seymour and Harry L. Neligan. Second edition, enlarged. Pp. lxvii + 299. (Dublin: Hodges, Figgis and Co.; London: Oxford University Press, 1926.) 7*s.* 6*d.* net.

THE original collection of true Irish ghost stories appeared in 1914, and elicited a large number of additional examples which warranted a second and enlarged edition; but publication was delayed owing to the War. The re-issue is justified by the additions. The collection covers a wide range of phenomena. The three chapters which are devoted to haunted houses include some remarkable experiences, many of which are off the familiar track. One quoted from the *Occult Review* describes the apparition of what was clearly an elemental with characteristic hairless face and unpleasant stench. The *poltergeist* stories, as compared with some which have appeared recently in the Press in England, are, on the whole, disappointing as psychic manifestations, and indeed, except in the cases recorded by the late Sir W. Barrett, resemble folk-tales relating to these appearances rather than genuine experiences. Of the ancestral ghosts, some are already familiar to students of folklore, among them being the Gormanstown foxes, real foxes which on one occasion appeared

in Dublin itself. There are several cases of invisible ghosts. One, if invisible, was ponderable, for when it jumped on the handle bar of a bicycle the rider was compelled to pedal down a steep hill. Of apparitions before, at, and after death, and of the banshee, there are, as might be expected, numerous examples. The compilers present the stories without comment, and of course do not guarantee their genuineness.

Biological Relations of Optically Isomeric Substances. By Prof. Arthur R. Cushny. (The Johns Hopkins University School of Medicine, the Charles E. Dohme Memorial Lectures, Third Course, 1925.) Pp. viii + 80. (London: Baillière, Tindall and Cox, 1926.) 9*s.* net.

IN this short monograph the late Prof. Cushny has given an account of the pharmacological behaviour of those drugs which exist in an optically isomeric form. Starting from Pasteur's work on the separation of the two forms of tartaric acid by means of the differences in their crystalline form, the author describes how optical isomers can be separated by combining them with another substance which is itself optically active or by means of physical agents, such as heat, which in certain cases lead to the development of different properties by the two isomers. The relation of enzymes to optical isomers and the fate of the latter in the living tissues are then dealt with. Following a section on their pharmacological action, to our knowledge of which the author himself contributed by his researches, the final and most interesting chapter is devoted to some general aspects of this subject. It appears probable that the specific activity of a drug depends on three factors: the general structure of the molecule, some special grouping, such as the alcoholic OH in the side chain of the acid in hyoscyamine, and, finally the presence of an asymmetric carbon atom. It is the latter which leads to a chemical combination between the drug and the cell, but it is on the second property that its specific action chiefly depends.

The Life of Buddha as Legend and History. By Dr. Edward J. Thomas. (The History of Civilisation Series.) Pp. xxiv + 297 + 4 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 12*s.* 6*d.* net.

DR. THOMAS makes a first-hand contribution to the subject, based on a wealth of new material; while at the same time he gives to the layman a fascinating biography of a personality mysterious and real, and, to the philosophic mind, perhaps the most attractive among all religious reformers. The account of Buddha's life in the first chapters provides perhaps the most interesting reading—as a story. The discussion of our literary sources of Buddhism in the introduction, and the analysis of the text in the appendix, allow the specialist and the scholar from the neighbouring fields of history and sociology to obtain a real glimpse into the foundations of our knowledge of Buddhism.

Most interesting and valuable, however, are the chapters discussing Buddhism as a religion and a philosophy, in its kernel of history, and in its aura of myth. The last chapter, containing a comparison between Buddhism and Christianity, shows how, in the light of modern scholarship, most 'parallels' and 'borrowings' vanish. While Seydel found fifty parallels, van den Bergh was reduced to nine, E. V. Hopkins to five, Garbe to four, Charpentier to only one, and "other scholars reject all connexion." The dogma of diffusion which has become of late so fashionable in anthropology, tends to disappear from history, that is, from the discipline which has full means of proving or disproving diffusion.

Recent Advances in Biochemistry. By John Pryde. Pp. viii + 348. (London: J. and A. Churchill, 1926.) 12*s.* 6*d.* net.

THIS excellent little book, a companion volume of "Recent Advances in Physiology," which we have already noticed in these columns, gives an up-to-date account of our knowledge on certain selected biochemical problems. It should be useful both to the advanced student and to the worker who wishes to keep abreast of his own subject in branches with which he may not be directly familiar, without the necessity of referring to the original work. Apart from chapters on the biochemistry of the proteins, fats, and carbohydrates, interesting accounts are given of the biochemistry of phosphorus and sulphur compounds, of the vitamins, and of hæmoglobin and related pigments: in each case the latest work, at the time of writing, has been included. The author has purposely omitted any account of the mechanisms of tissue oxidations and the chemistry of the internal secretions, since both have been dealt with in the companion volume: instead, he has included two extremely useful chapters on the chemical basis of specific immunological reactions and on chemotherapy, subjects which are not often included in text-books of biochemistry: they are, however, among the most interesting of those dealt with in this volume. We can confidently recommend this book to all those interested in this subject.

An Introductory Course of Mathematical Analysis. By Charles Walmsley. Pp. x + 293. (Cambridge: At the University Press, 1926.) 15*s.* net.

DR. YOUNG in his preface to this book explains that it was written to meet the needs of first-year students at Aberystwyth, many of whom arrived entirely ignorant of trigonometry, while others were proposing to take mathematical honours. Only the university authorities can judge of the success with which this staggering problem has been solved, but Mr. Walmsley has evidently been more concerned with the latter class than with the former, and his work will probably be useful chiefly as an introduction to Hardy's "Pure Mathematics."

So far as it goes, the treatment is thorough and sound: special attention is paid to inequalities and inequations, and a good feature is the proof of the addition theorems for the trigonometrical functions defined by their series.

Letters to the Editor.

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Atmospheric Ozone and Solar Variability.

IT has been known for a long time that variations in the annual mean values of the daily magnetic range were closely related to variations in the annual sunspot numbers. During recent months a number of other widely different terrestrial phenomena have been found correlated to some extent, at least, with solar changes and with each other.

Dr. C. G. Abbot has found that the monthly mean values of solar radiation show variations of the same character as do the monthly and annual sunspot numbers (*U.S. Monthly Weather Review*, vol. 54, No. 5, May 1926). Mr. Greenleaf Pickard showed that there was a marked correlation between variations in sunspot numbers and radio reception at Newton, Massachusetts, and at Washington, D.C. The comparisons were made with wave-lengths of

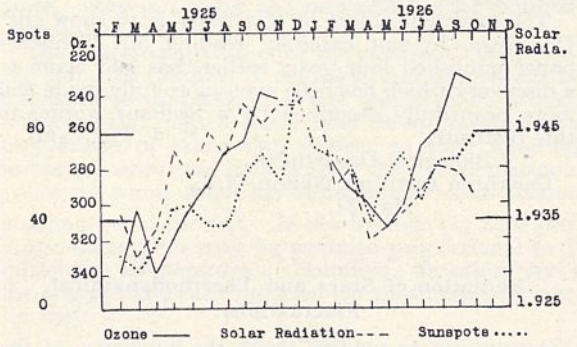

FIG. 1.

8-9 megacycles, 15-25 kilocycles, and 1330 kilocycles. The measurements of the 8-9 megacycles and 1330 kilocycles were made at night, and those of the 15-25 kilocycles were made during daylight (Institute of Radio-Engineers, session of Jan. 10, 1927). Dr. L. W. Austin, of the U.S. Bureau of Standards, has shown that there is a strong correlation between the monthly means of radio receptivity and the monthly means of the Smithsonian measurements of solar radiation, and Dr. C. G. Abbot has found a marked relation between the total solar radiation and the ultra-violet radiation as measured by Dr. Pettit of the Mount Wilson Observatory. However, the variation in ultra-violet radiation is much larger, showing a range of about 60 per cent., while the total radiation shows a range of less than 5 per cent. (*Smithsonian Miscellaneous Collections*, vol. 80, No. 2, April 1927).

During the past two years Dr. G. M. B. Dobson, Dr. D. N. Harrison, and A. Lawrence, S.J., have made measurements of the amount of ozone in the earth's atmosphere at Oxford (*Proc. Roy. Soc.*, A, vol. 114; 1927). The monthly means of these values show an inverse relation to the monthly means of solar radiation as measured by the Smithsonian Institution and also to Dr. Wolfer's sunspot numbers. In the accompanying plot (Fig. 1) the continuous line shows the variations in the monthly means of ozone at Oxford, the broken curve shows the variations in solar radiation, and the dotted curve shows the variations in the monthly sunspot numbers.

The following table gives the departures of these three elements from the means of 19 months, using all the data available from Oxford. The mean values are, for ozone, 0·284 cm. of pure gas, sunspots 52, solar radiation, 1·940 gm. cal. per sq. cm. per sec.

DEPARTURES FROM MEANS OF 19 MONTHS.

1925.				1926.			
	Ozone.[1]	Sun-spots.	Solar Rad.[2]		Ozone.[1]	Sun-spots.	Solar Rad.[2]
Feb.	+56	−29	−4	Feb.	− 6	+17	−1
Mar.	+20	−34	−9	Mar.	+ 6	+12	+1
April	+56	−20	−7	April	+ 5	−13	−7
May	+37	− 9	+3	May	+29	+12	−6
June	+12	− 4	−4	June	+17	+20	−3
July	+ 5	−13	+5	July	−18	− 4	0
Aug.	−11	−14	+2	Aug.	−26	+11	+2
Sept.	−18	+ 8	+8	Sept.	−56	+ 9	+1
Oct.	−45	+17	+6	Oct.	−52	+26	−2
Nov.	−37	+ 7	+8	Nov.	..	..	..

[1] Unit 0·001 cm. [2] Unit 0·001 gm. cal.

From these numbers the correlation coefficient for ozone and sunspot numbers comes out, $r = -0{\cdot}62 \pm 0{\cdot}09$, and for ozone and solar radiation, $r = -0{\cdot}54 \pm 0{\cdot}11$. Presumably the correlation would be even higher with Dr. Pettit's measurements of ultra-violet solar radiation, but the figures of his measurements are not at hand.

Dr. Dobson and his associates believe that there is an annual period shown by the ozone measurements, and there probably is such a period, but its value cannot be determined from the data at hand; because while the ozone values decreased from about April to October in both years, it happens that the sunspot numbers and also the solar radiation values (both those of Abbot and Pettit) increased from April to October in each year, and as there is an apparent negative correlation between these values and ozone at Oxford, it will take a number of years of observation to determine the terrestrial influence.

When the variations shown by the monthly means are eliminated and the day-to-day residuals are compared with sunspots, the relation between them is not evident. In 1925 the correlation coefficient was negative and in 1926 it was positive. But this result is not surprising. Dr. L. A. Bauer and C. R. Duvall found that the same thing was true of terrestrial magnetic variations (*Terrestrial Magnetism and Atmospheric Electricity*, Dec. 1925). The relation of these day-to-day magnetic variations to solar changes is different from that of the monthly means and its laws remain yet to be determined. In the case of solar radiation, the short period changes are connected in some way with the passage of spots with their accompanying clouds of calcium across the central part of the sun's disc, as I pointed out in NATURE of Jan. 13, 1921, p. 630.

Dr. Dobson and his associates have shown that there is a very close relation between the day-to-day variations of ozone and the variations in pressure and temperature, more especially in the upper air. If future observations shall confirm the relation between the ozone values and variationsin terrestrial magnetism and relate these to solar changes, they may furnish the key as to how solar radiation changes influence our atmosphere. Dr. Dobson has now established a network of stations for observing ozone, the preliminary results of which appear to show that there is an increase in the quantity of ozone and its variability from the tropics towards the pole. Since the ozone is found chiefly in the stratosphere, it may be that the increase of ozone with increase of latitude is associated with the increase in the depth

of the stratosphere which is found with increasing latitude. The increased depth of the stratosphere over areas of low pressure may also explain the increase of ozone with decrease of pressure in high latitudes.

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The Mechanism of the so-called 'Posterior Sucker' of a Simulium Larva.

IN NATURE of April 23, p. 599, there appears a letter from Dr. Sunder Lal Hora of the Indian Museum, Calcutta, on the subject of the mechanism of the so-called 'posterior sucker' of the Simulium larva, in which he describes the true method of progression of this remarkable larva. In the course of his remarks, Dr. Hora quotes a passage from Tonnoir (*Ann. Biol. Lacustre*, **11**, pp. 163-172; 1923) to the effect that this worker, "not finding any muscles inserted in the middle of the disc, doubted its utility as a true sucker and ascribed the function of attachment to the hooks alone." He then goes on to discuss Dr. Puri's well-known paper (*Parasitology*, **17**, pp. 295-369; 1925).

Mr. Tonnoir worked at the life-histories of New Zealand Simuliidæ during part of his two years' tenure of a research studentship at this institute, 1921–23, and the paper mentioned above contains some of his observations on the biology of Simulium larvæ. Apparently Dr. Hora has not understood the paper, but only made use of the last sentence in Section I., p. 165, as quoted by Dr. Puri, which is the least important of all Mr. Tonnoir's observations. The whole section, pp. 163-165, entitled "Progression et fixation des larves," deals very fully with the points raised in Dr. Hora's letter, and reaches exactly the same conclusions as he does, only they are given in more abundant detail and as the result of longer and closer studies of the larvæ in specially constructed running-water aquaria designed by Mr. Tonnoir himself.

May I be allowed to quote, side by side, the two sets of observations as briefly as possible:

(1) Tonnoir: "*Les larves ne sont pas munies de ventouses; . . . il faut définitivement abandonner cette théorie des ventouses tant postérieures qu'antérieures.*"

Hora: "the posterior appendage does not act as a sucker, but fixes itself with the help of hooks alone."

(2) Tonnoir: "La larve fixe *toujours*, *sans exception*, l'extrémité postérieure de son corps exactement à l'endroit où se trouvait sa tête un instant auparavant, et, pendant le court instant où elle forme la boucle avec son corps, sa couronne de crochets postérieure (la soi-disant ventouse) vient *toujours* en contact avec sa bouche." "La larve dépose, avec sa bouche, une certaine quantité de matière glutineuse (dont elle forme ordinairement ses fils de soie) sur ces crochets postérieurs et sur le support; ainsi fixée solidement par l'extrémité postérieure, elle redresse ensuite son corps et l'étend, de toute sa longueur, en avant, pour se fixer au support par la bouche contre laquelle se trouvent appliqués les crochets terminaux de la fausse patte antérieure; elle ramène alors en avant, en se pliant en U, son extrémité postérieure et la série des mouvements se répète."

Hora: "These [the sucker-hooks] are capable of gripping firmly a cluster of silk threads (the sticky salivary secretion) which the animal secretes on the spot where it intends the posterior appendage to be fixed."

The only differences between the two accounts are that Dr. Hora supplements the lack of detail in his account by giving a figure of the tracks of the sticky secretion made by the larva, whereas Tonnoir's detailed account makes a figure unnecessary.

The real difference in interpretation lies in the question of the muscles of the so-called 'posterior sucker.' In the larvæ of Blepharoceridæ, where true suckers are present, the muscles are of great strength, much stronger than the ordinary segmental muscles; this requirement is obvious, when one reflects that the vacuum is produced within the suction area by the long-continued *contraction* of these same muscles. The muscles of the 'posterior sucker' in Simulium larvæ, on the other hand, are much weaker than the segmental muscles, as Dr. Puri's figure (pl. viii. fig. 10) clearly shows, and could not possibly accomplish this function. Tonnoir had the blepharocerid larva in mind (on which he was also working at the time) when he wrote "il n'existe pas de faisceaux musculaires destinés à la formation de cette coupe"; he did not imply that *no* muscles existed, but only that *no muscles strong enough* existed. To call these muscles 'strong,' as Dr. Hora does, seems to me misleading; they are strong enough to pull the disc from the sticky secretion, but, compared with the segmental muscles, and more especially with the sucker muscles of Blepharoceridæ, they should be described as 'weak.'

The principal object of this letter is to show that Dr. Hora, by not carefully reading Mr. Tonnoir's paper published four years earlier, has laid claim to a discovery which has been even more fully made and more beautifully described by a brilliant worker in this Institute.

R. J. TILLYARD.

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Cawthron Institute, Nelson, N.Z.,
May 31.

Radiation of Stars and Thermodynamical Fluctuations.

ACCORDING to modern views the substance of the sun and stars is in a state closely approximating to that of a perfect gas. These spherical gaseous bodies have been extensively studied on the basis of classical thermodynamics. It can scarcely be doubted that the internal layers of a star are in an almost perfect thermodynamical equilibrium having a radiative character, as has been convincingly established by Eddington.

It is only in the close proximity of the surface that considerable deviations from this state of equilibrium can occur.

In this note I wish to suggest that the theory of the stars may be greatly enlarged and improved by an introduction of a new agent, namely, thermodynamical fluctuations.

It is shown in statistical mechanics that the thermodynamical equilibrium is never absolute, there are always fluctuations, namely, irregular oscillations about a state of equilibrium.

When the system under examination is closed this state undergoes no change in the course of time. But a star must be regarded as an open system, which can exchange energy with surrounding bodies. In such a system the exact balance of fluctuations cannot exist either on the surface or in the deep interior. In these conditions the external radiation will appear as a necessary consequence of fluctuations.

The thermodynamical fluctuations may be of different kinds. The most important for our purpose are the fluctuations of emission and absorption. If E is the energy of full radiation contained in a volume

V, of frequencies corresponding to the interval ν, $\nu + d\nu$; E_0, its mean value; $\epsilon = E - E_0$; $\overline{\epsilon^2}$, the mean value of ϵ^2; h, Planck's constant; c, velocity of light, then

$$\overline{\epsilon^2} = h\nu E_0 + \frac{c^3}{8\pi\nu^2 d\nu}\frac{E_0^2}{V}.$$

The first term on the right side of this equation depends on the fluctuation of emission and absorption; the second term originates from the interference of rays crossing the volume V in all directions. Denoting the first part of $\overline{\epsilon^2}$ by $\overline{\epsilon_1^2}$ we have

$$\sqrt{\overline{\epsilon_1^2}} = \sqrt{h\nu E_0}. \quad . \quad . \quad . \quad (1)$$

In what follows we shall apply this formula to the total radiation contained in a volume V, understanding by ν a mean frequency. In certain elements of a star the quanta $h\nu$ of energy are produced in an excessive number; in the other, it is the inverse process of absorption which predominates. The compensation of these two opposite processes is not complete with regard to the external radiation of the star. Imagine the centres of increased emission and absorption irregularly disseminated throughout the total volume of the star; a part of the excessively emitted radiation gets free of the star into interstellar space. This is, I think, the mechanism of the external radiation of stars.

The exact computation of the resultant effect arising from fluctuations of emission and absorption in innumerable elements of a star seems to be a very difficult task. Much easier may be an approximate comparison of stars with respect to their external radiation considered as a shining due to fluctuations.

Let us admit that this radiation per unit volume is proportional to $\sqrt{\overline{\epsilon_1^2}}$. In the formula (1) E_0 is proportional to T^4, ν may be assumed proportional to T (absolute temperature); therefore, denoting by σ the energy externally radiated per unit mass of a star, we have

$$\sigma = a\rho^{-1}T^{\frac{1}{2}}, \quad . \quad . \quad . \quad . \quad (2)$$

where ρ is the mean density, a a constant coefficient. This law of radiation is no more than a rough approximation; nevertheless, it explains in a striking manner the diversity of the outflow of radiation per unit mass from different stars.

Let us in the first instance compare the sun with Capella (the brighter component). The data necessary for us derived from astronomical observations are as follows: $\sigma_{\text{Capella}} = 58$, $\sigma_{\text{Sun}} = 1{\cdot}9$, whence $\frac{\sigma_C}{\sigma_S} = 30{\cdot}5$; the density of the sun is 620 times that of Capella, the temperature is 4·3 times higher in the sun at corresponding points.

Eddington considers as a natural supposition that σ must be proportional to the density and to some higher than first power of temperature, say, second power. It follows that the quotient σ_C/σ_S should be about $\frac{1}{12000}$.

We have here, as Eddington points out, an "awkward paradox" (see "The Internal Constitution of the Stars," p. 397).

Our formula (2) gives an explanation of the fact that with a smaller density is associated greater external radiative power; for the quotient σ_C/σ_S we obtain 16·2 instead of 30·5: the better agreement might not be expected.

We may also compare the sun with the variable star δ Cephei. We have $\frac{\sigma\delta\ \text{Cephei}}{\sigma_{\text{Sun}}} = 55$; the density of the sun is 4120 times that of δ Cephei, the temperature of the sun is 6·6 times higher. From formula (2) we obtain $\frac{\sigma\delta C}{\sigma_S} = 37$. Thus the confrontation of theory and observational data provides a serious argument supporting the view that the external radiation of stars is a consequence of thermodynamical fluctuations.

Further consideration of this subject will be found in a communication presented to the Polish Academy of Sciences on June 10, 1927.

TCHESLAS BIALOBJESKI.

Warsaw, June 20.

The Transition from Ordinary Dispersion into Compton Effect.

THE dispersion formula of Kramers and Heisenberg is valid for an atomic system the dimensions of which are small compared with the wave-length of incident light. For very short waves the scattering from an atom will of course approach the Compton effect for free electrons; and this has been treated very fully by Dirac and Gordon. A treatment of dispersion theory on the basis of wave mechanics has been given by Schrödinger and Klein, who have also outlined a simple treatment of the Compton effect. Following a procedure rather analogous to that of Klein, it is possible to work out a generalised dispersion formula, holding also for waves short compared with atomic dimensions and making it possible to follow the gradual transformation of ordinary dispersion into the Compton effect.

For elements of low atomic number this transformation can be followed through various stages. The following brief account relates to an atom containing only one electron. During the first stage, while the wave-length of the radiation remains throughout long compared with atomic dimensions, its frequency varies from being of the same order as the characteristic frequencies of the atom to values large in comparison with these frequencies. The characteristic dispersion gradually transforms into the scattering, which must be expected on ordinary electrodynamics for free electrons, and which is given by the well-known formula of J. J. Thomson. This formula holds approximately down to wave-lengths approaching atomic dimensions. At that stage the scattering of coherent radiation will begin to diminish and will gradually be more and more concentrated in the direction of the incident light. Simultaneously with this effect, an incoherent radiation of frequencies equal to the difference between the incident frequency and the characteristic absorption frequencies of the atom will appear.

At first the intensity of this radiation will be mainly distributed over a few frequencies, the light of each component being scattered in all directions. As the wave-length decreases, the distribution of intensities amongst the various components of the scattered radiation will become more and more nearly a distribution which gives the well-known relationship between direction and frequency for the Compton effect, and also the intensity formula of Breit and Dirac. The phenomenon will have practically merged into the Compton effect when the momentum of a quantum of the incident light is large compared with the mean value of the momentum corresponding to the electronic motion in the atom. It is of interest to note that even at this stage the Thomson formula holds with a close approximation for the total intensity of the scattered light in any direction. This formula first ceases to hold approximately when the frequency displacement of the Compton effect is no longer small compared to the frequency of the incident light.

The mathematical discussion of the problem in question makes use of the fact that in the region where the frequency of the light is large compared with the natural frequencies of the atom, it is possible to calculate the scattering with high approximation directly from a knowledge of the wave functions of the undisturbed atom, the calculation being in this respect simpler than that of ordinary dispersion theory. It may be noted that the coherent part of the radiation is in this case directly calculated from that continuous distribution of electricity which is defined by Schrödinger's density distribution in the initial state of the atom.

I wish to express my thanks to Prof. N. Bohr, Prof. C. G. Darwin, and Dr. O. Klein for their valuable interest in this work, of which a fuller account will be published shortly.

IVAR WALLER.

Copenhagen, Universitetets Institut
for teoretisk Fysik,
June 1.

The Mounting of Thin Glass Windows.

RECENTLY (early spring of 1926) it became desirable to produce a source of α-rays free from the disturbing effects of the accompanying emanation. This source was to be used in connexion with a simple α-ray track apparatus designed by the writer (*Jour. Optical Society of Amer.*, vol. 11, No. 2, Aug. 1925; *Science*, vol. 64, No. 1649, Aug. 6, 1926). The solution came from a suggestion by one of the writer's students, L. P. Garner, a graduate in electrical engineering, University of Illinois, and for the above purpose leaves nothing to be desired. Briefly it is as follows: A cane *c* (Fig. 1) of solid glass (Pyrex or Monax) is broken off squarely. On the centre of this end is placed a

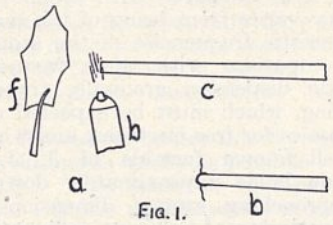


FIG. 1.

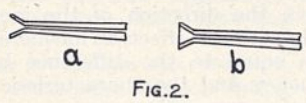


FIG. 2.

FIG. 3.

minute film of dilute shellac, which serves to hold a microscopic quantity of radioactive salt (radium bromide was used). Now prepare a film *f* by blowing it out of the *same glass* and so thin that it will *show Newton's rings*. Hold this film with a pair of forceps in front of and distant about $\frac{3}{4}$ inch from the tip of the cane bearing the radioactive salt and bring them up to a soft blast *b*, as shown in Fig. 1, *a*. Heat carefully, and as soon as the square tip begins to assume a globular form *thrust it through the film f*. The result is a varnish of glass, as it were, enveloping the front side of the globule as shown in Fig. 1, *b*. The burr is now brushed off and the emanationless source of α-rays is ready for use, providing no mishap was encountered.

A step further in the process is the fusing on of glass windows. This has been carried out during the past few months at the Cavendish Laboratory. Figs. 2 and 3 show the essential steps. The cavity on which the window is to be fused should be prepared with care, the lip should be square and symmetrical, and the glass walls should be rather heavy. Best results will be secured by the beginner if the opening of the cavity to be glazed be not more than 2 mm. inside diameter. The capillary leading to the cavity may have, of course, any dimension desired. If a plane window is desired the capillary must not be obstructed during the operation. The procedure is the same as for the solid cane. Care must be taken not to overheat the edge of the cavity or else it may become deformed; also this hot edge when thrust through the film *f* must strike it squarely—an operation that succeeds after several trials. Windows of 0·05 mm. thickness and 2 mm. diameter will withstand a vacuum either in or out.

A much thinner film of glass may be used for a given diameter of window if it is fused on concave or convex, as shown in Fig. 3, *a* and *b*. The process after all is very simple. To produce a concave window attach the capillary cane to an aspirator stopped down to produce an exceedingly small suction, and proceed as above. The amount of concavity produced is readily regulated by adjusting the suction. Again, to form a convex window it is only necessary to close the capillary with a little soft wax while fusing it on. The expanding air within will give it the desired convexity. A few trials may be necessary. When successfully done these fused junctions are vacuum tight and present a beautiful appearance under a magnifying glass.

Windows thus fused on should prove useful in a number of researches with α-rays.

CHAS. T. KNIPP.

Cavendish Laboratory,
Cambridge, June 30.

Modern Photometry.

I WISH to clarify a somewhat confused account of some work of mine given in Walsh's "Photometry," pp. 244-245 (London: Constable, 1926). Since the same mistake has also been made by others heretofore and bids fair to become prevalent, it seems desirable to publish a correction. I do this not for the sake of finding fault, but to prevent, in so far as possible, the continued spread of mistaken ideas in regard to the subject matter in question. It is well known how errors once incorporated in a standard text are copied and re-copied without limit.

The error in question is that the instrument designated by Dr. Walsh as "The Leucoscope" is *not* the leucoscope, but the "rotatory dispersion colorimetric photometer." The pertinent facts are as follows:

(1) The leucoscope is an instrument the invention of which is commonly attributed to Helmholtz, about 1870–80. There has been some slight controversy as to the relative contributions of Helmholtz, and one of his pupils, Diro Kitao, to its development. Edm. Rose (1863) described an instrument which may be regarded as the prototype of the leucoscope. A review of the history of the instrument and a full bibliography have been published in my paper on the leucoscope (*Jour. Op. Soc. Am.*, **4**, 448-495; 1920). It consists essentially of a quartz plate between a *Wollaston* prism and a nicol prism through which the observer views *two* images of the *same source*.

(2) The instrument which Dr. Walsh describes and calls "The Leucoscope" is properly called the "rotatory dispersion colorimetric photometer" (*J.O.S.A.*

and *R.S.I.*, **7**, folded insert facing p. 1199; Dec. 1923). I particularly object to naming it "Priest's leucoscope" as is done in the index of Dr. Walsh's book. It is a special form of the Arons' chromoscope (Leo Arons: *Ann. der Phy.* (4), **39**, 545-568; 1912), and its embryonic form may be seen in Zoellner's colorimeter (J. C. F. Zoellner: "Photometrie des Himmels," Berlin, 1861. G. Mueller: "Photometrie der Gestirne," pp. 244-254; Leipzig, 1897). My connexion with this instrument has been to develop the theory and practice of its use in the colorimetry and photometry of incandescent sources and daylight, and to design an instrument especially suited to these purposes.

(3) In principle, manner of use, and specific purpose served, the two instruments are very different. About all that they have in common is the fact that they both contain nicol prisms and quartz plates and the circumstance that I have written papers dealing with each of them separately.

It seems unnecessary to occupy space by setting forth in detail the distinctions between these two instruments. All confusion may be removed by consulting my papers which deal respectively with the two different instruments, namely, "A New Study of the Leucoscope . . ." (*J.O.S.A.*, **4**, pp. 448-495; Nov. 1920), and "Colorimetry and Photometry . . . by the Method of Rotatory Dispersion" (*J.O.S.A.* and *R.S.I.*, **7**, pp. 1175-1209; Dec. 1923).

IRWIN G. PRIEST.

Department of Commerce,
Bureau of Standards,
Washington, June 21.

MR. IRWIN G. PRIEST has been good enough to send me a copy of the above letter concerning the description, in my recent book "Photometry," of the instrument developed by him for heterochromatic photometry (pp. 244-5).

While agreeing, of course, that his instrument is in no wise identical, either in principle or in use, with Helmholtz's 'Leucoscope,' it still appears to me that 'Leucoscope Photometer' is a not inappropriate description of the instrument, which is, in essence, a photometer in which a colour match is obtained by means of the rotatory dispersion of quartz, and a brightness match by means of polarisation prisms. Nevertheless, it is clear that as Mr. Priest is the inventor of the instrument, he must necessarily be entitled to object to having any name attached to it which, in his opinion, is liable to lead to misunderstanding. I can therefore assure him that should a further edition of my book be called for, the alteration will certainly be made. In the meantime I feel sure Mr. Priest will agree that the *description* of the instrument which I have given in the text of my book is in no way misleading.

JOHN W. T. WALSH.

The National Physical Laboratory,
Teddington, Middlesex,
July 6.

The Dissociation of Carbon Dioxide at High Temperatures.

WHEN mixtures of carbon monoxide and air in varying proportions are exploded in a closed vessel under similar initial conditions of pressure, temperature, and moisture content, experiments show that the greatest explosion pressure occurs when the proportion of carbon monoxide to oxygen in the mixtures is greater than 2. Messrs. Fenning and Tizard, in their paper on the dissociation of carbon dioxide at high temperatures in a recent number of the *Proc. Roy. Soc.*, assume that chemical equilibrium is established by the time the maximum pressure is reached in explosions and attribute this phenomenon entirely to temperature dissociation of carbon dioxide. They then proceed to make estimates of the dissociation of carbon dioxide as a function of temperature from explosion experiments in which the 'airs' used were enriched with oxygen so as to develop higher temperatures.

The assumption that chemical equilibrium is attained at the maximum pressure in explosions is, I believe, erroneous and dissociation values calculated from explosion experiments upon this basis are much too high.

Some earlier experiments of mine in which measurements of heat loss were made during explosion convinced me that chemical equilibrium is not attained at maximum pressure—at any rate in explosions of complex mixtures like those of coal-gas and air. Recently we have been working in Leeds with pure gases (carbon monoxide and hydrogen) and have come to the conclusion that even with such gases chemical equilibrium is far from being attained at maximum pressure. One of the methods employed is, on the experimental side, precisely similar to that adopted by Messrs. Fenning and Tizard, but the range of our experiments is wider in that we have made investigations at explosion temperatures so low that dissociation is insignificant as well as at higher temperatures. Thus Mr. R. A. Smith, a research student, has experimented with carbon monoxide explosions, varying his 'airs' so as to investigate the temperature range 1600° C. to 3000° C. His experiments prove that the amount of uncombined gas at the maximum pressure in 'complete combustion mixtures' is *at least* 10 per cent. of the original charge when the explosion temperatures are below about 2000° C., but as the explosion temperatures are increased the amount of uncombined gas increases. The explanation would appear to be that below 2000° C. the uncombined gas is due to incomplete combustion and that above 2000° C. dissociation adds to this. It seems clear, then, that the assumption of chemical equilibrium at maximum pressure is unjustifiable.

Mr. Smith's explosion vessel consists of a sphere 6 inches in diameter, and the gaseous mixtures before explosion were at atmospheric temperature and density. Our work suggests the desirability of experimenting with vessels of various sizes and shapes and also at various densities, and we propose to arrange for this before publishing our results in detail.

W. T. DAVID.

Engineering Department,
The University, Leeds,
July 16, 1927.

Polyploidy within a Species.

THE importance of taking chromosome characters into consideration in the study of genetical problems is becoming increasingly more apparent, particularly in relation to the species problem, and any peculiarity in this respect requires careful attention. The study of large genera and of the occurrence of polyploidy within their limits, as exemplified by Rosa and other genera, has thrown considerable light on the origin and interrelationships of the various species. In investigating Silene and the neighbouring genera from this point of view, the actual base number of chromosomes is itself of considerable interest, since in Saponaria and Dianthus it may be 14 or 15, whereas in Silene, etc., it is invariably 12. So far, however it is these latter genera, Silene, Melandrium, Lychnis,

etc., which have chiefly occupied my attention, and it appeared, at first, as if the question of polyploidy scarcely arose at all; even now, after the investigation of more than sixty species, only seven have been found to be other than diploid. Among these, however, one, *Silene ciliata*, has shown itself of such exceptional interest that it seemed to me worth while directing special attention to it. In the genus Silene, although more than thirty species have been examined, only two show polyploidy: of these *S. vallesia* is a normal tetraploid, whilst in the case of *S. ciliata* I have investigated two races, one of which is tetraploid and the other has a haploid count of 96 and is therefore 16-ploid. The plants of this latter race were perfectly normal in chromosome behaviour and fertile. The two races were obtained from different sources and both were quite typical, and this within a species which is somewhat variable.

Although cases are known in which tetraploidy does not produce a 'gigas' form, it does seem somewhat surprising that a race can arise with four times the normal number of chromosomes, and with actually the largest but one recorded figure for angiosperms, and yet show no obvious difference in appearance.

That this is a case of continuous duplication of chromosomes rather than segmentation of the individual chromosomes is strongly suggested by the observation that the size of the chromosomes is little less in the case of the 16-ploid race; even the characteristic ring shape at the heterotype division is retained. The volume of the pollen mother-cell in the two forms is very little different, that of the tetraploid being about three-quarters that of the 16-ploid. The chief difference in cytological appearance is due to the extremely close packing of the chromosomes in the latter case.

This record seems to minimise the value which has frequently been attached to mere multiplication of chromosome sets and, at any rate within the limits of the Silenoideæ, to emphasise the importance of the original set characteristic of the genus.

KATHLEEN B. BLACKBURN.
Armstrong College (University of Durham),
Newcastle-upon-Tyne, July 4.

Optical Behaviour of Protein Solutions.

A VERY remarkable increase in light-scattering power is exhibited by gelatine solutions when the hydrogen-ion concentration approaches the value (about $p\mathrm{H} = 5$) corresponding to the iso-electric point. This effect, which appears to have been known for some time, has been recently studied in detail by Kraemer and his co-workers, who give interesting curves showing the manner in which the Tyndall effect varies with $p\mathrm{H}$ and temperature ("Colloid Symposium Monograph," vol. 4, and *Journal of Physical Chemistry*, May 1927).

The phenomena are scarcely intelligible on the view commonly adopted that the Tyndall effect in a colloidal solution is simply proportional to the number of scattering particles of the same kind present in it. Their explanation becomes clearer if we apply to colloidal solutions the general thermodynamic theory of light scattering, in which the Tyndall effect is regarded as due to local fluctuations of optical density in the medium. According to the latter theory, the scattering power of a colloidal solution would be connected with the osmotic pressure P of the particles, by the relation

$$\frac{\pi^2 RT}{2N\lambda^4} \frac{k(\partial\epsilon/\partial k)^2 \rho/m}{\partial P/\partial k}, \quad . \quad . \quad . \quad (1)$$

where k is the concentration of the dispersed material, ϵ is the optical dielectric constant of the solution and ρ/m is practically unity for a dilute solution. It is well known from the work of Jacques Loeb that the osmotic pressure of a gelatine solution alters in a notable manner with $p\mathrm{H}$, becoming very small at the iso-electric point. Equation (1) then enables us to see at once why the Tyndall effect becomes very large under the same conditions.

A detailed discussion of colloidal optics on the basis of the thermodynamic theory of light scattering will be published in the *Indian Journal of Physics*.

C. V. RAMAN.

The Relationship between Chinese and Arabic Alchemy.

SINCE my communication on the subject of Chinese alchemy (NATURE, Jan. 1, 1927) was written, I have received the very important memoir entitled "Chemistry in Iraq and Persia in the Tenth Century A.D.," by Principal Stapleton, the late Mr. Azo, and Mr. M. H. Husain, published in the *Memoirs of the Asiatic Society of Bengal*, vol. 8, No. 6, 1927. In this (p. 405) the treatise on Taoist alchemy, *Pao p'o tsz* of Ko-Hung (A.D. 330), to which I referred, is mentioned, and a summary of the alchemical contents of three of the 'Inner chapters' (*Nuy peen*), translated from an edition published in 1884, is given. This information does not go further than that already published, and it would seem that the account given by Edkins is nearly complete. The authors then remark (p. 406) that: "The above account is sufficient to prove (*a*) that Chinese alchemy was concerned almost entirely with Mineral Chemistry: and (*b*) that Ko-Hung's materials were so extraordinarily similar to those used by Arabic and Greek alchemists that it is certain that Chinese, Greek, and Arabic alchemy must have had a common source of origin." They also refer (p. 405) to "a further possible source of Arabic alchemy, namely, the Chinese School of Alchemy which was flourishing at least as early as 200 B.C."

It will be seen that the distinguished Oriental scholar has reached the same conclusion as myself: the only difference between us appears to be that he regards Chinese alchemy of 200 B.C. as well established, whilst I consider that this still awaits satisfactory demonstration. An examination of the information dealing with this earliest period by a competent expert is still necessary.

J. R. PARTINGTON.
Kingsbury Close, London, N.W.9.

Fictitious Amazons.

THE efforts of syndicated journalism to popularise research occasionally lead to misunderstandings. I have to-day received a cutting from the *Daily Mail* of Bombay, dated June 14, devoting two columns to discussion of views about the ancient Amazons, which I am represented as having maintained at a meeting of the British Association for the Advancement of Science. Will you give me the opportunity of saying that neither before the British Association nor before any other public body have I discussed the ancient Amazons at all. Similar announcements have been appearing in French, Belgian, and especially in American, papers during the past six months, in connexion with the Philadelphia meeting of the American Association last December. It is true that I attended that meeting as the representative of the British Association, and gave a public lecture on some aspects of the geography of Greek lands; but that lecture contained no reference to the Amazons.

Will Indian, French, Belgian, and especially American newspapers 'please copy'?

JOHN L. MYRES.
New College, Oxford, July 19.

The Resources and Applications of Manganese.

OUR very material and complex civilisation, admittedly only rendered possible by the developments in metallurgy, is indebted to the chemists of the eighteenth and early nineteenth centuries to an extent not always appreciated for their success in isolating the elements, and particularly the metals. Their efforts were largely sustained by the desire for knowledge, since material reward in the modern sense could scarcely be contemplated, and, indeed, did not enter into the thoughts of many of these pioneer investigators. The world owes much to the Swedish chemist Gahn, who first successfully isolated the metal manganese in the latter half of the eighteenth century. As regards the application of the element in the metallurgy of steel, the two outstanding names are Mushet and Hadfield. Mushet discovered its value when added in small quantities in the manufacture of ordinary commercial steels; whilst Hadfield produced an alloy of iron and manganese having properties entirely new and unsuspected in the range of ferrous metallurgy. Hadfield's manganese steel led the way in the successful development of alloy steels. This material, when quenched in water from a high temperature, becomes soft and tough, whereas previous steels became hardened by such treatment. By virtue of the discovery of such phenomena, investigators were led into a proper appreciation of the changes taking place in iron and steel with change in temperature. To Sir Robert Hadfield we are indebted for two extremely interesting papers presented at the May meeting of the Iron and Steel Institute: one reviewing the world's resources of manganese; the other containing the results of his latest researches on the iron-manganese-carbon system. It is of value that an investigator who over a long life of continuous research in a field which he has made peculiarly his own, should review the subject.

When it is remembered that manganese was only first isolated in 1774, the metallurgical achievement at the present time of smelting $2\frac{1}{2}$ to 3 million tons of ore is indeed considerable. Such are, however, the advantages of the alloying of the metal with iron that it is indeed desirable to review the position, particularly in regard to the British metallurgical industries. In an interesting and valuable contribution to the discussion upon these particular papers, Sir Thomas Holland quite rightly asks whether, and to what extent, scientific and technical matters such as these should be confined in discussion to technical institutions, and whether the larger public should be instructed in the economic and political aspects of the matter. The discussion in which Sir Thomas took part undoubtedly gives the answer, since the extent of the resources and the distribution of the ores were brought home to a large audience, many of whom no doubt were instructed by the paper and the ensuing speeches. Particular attention might be directed to an excellent map given by Sir Robert Hadfield showing the known sources of manganese ore in relation to the British Empire, and whilst it is clear that we have excellent deposits within the Empire's borders, it is also clear that to retain the advantage of them, and to receive adequate supplies for the home industries, our sea routes must be kept open. India, the Gold Coast, Russia, and Brazil are indicated as the largest present sources of supply; large deposits not fully developed occur in South Africa, Europe, and South America; whilst there are few parts of the world where the ore is not worked. Cost, however, is vital, and the richest, more easily available, and the nearer the deposits, the better is it for the consuming industry.

Turning to the commercial reduction of the metal from the ore, the survey of the development indicates rapid technical progress. The discovery of the influence of manganese in facilitating the production of good steel by Sir Henry Bessemer's process, naturally led to concentration upon the matter of supplies of the metal.

It is described how Heath in 1839 first made the application of manganese to steel production possible by the use of his 'carburet of manganese,' but it should be remembered that at that date, and for some time afterwards, liquid steel could only be produced in small crucibles which men could lift. It was the advent of Bessemer's process, described by him in 1865, which made possible the engineers' dream of a mechanical world based on iron and steel. Without manganese, the process was not practicable. Largely through the experiments of Mushet, who had been working at the production of metallic manganese from 1830 onwards, it was shown that the addition of manganese to Bessemer's blown metal produced a very tough workable steel, and ensured the commercial success of the process destined to revolutionise everything, since, for the first time, cheap steel in great quantities became possible for the multiplication of railways and ships, and a multitude of minor services upon which our civilisation is so dependent. By 1865, at the suggestion of Bessemer, Henderson in Glasgow was making an alloy of iron and manganese, containing 25 to 30 per cent. manganese, by his own process, which consisted of reducing, upon the hearth of a Siemens' furnace, "a mixture of carbonate of manganese and oxide of iron in the presence of excess carbon by means of a neutral or reducing flame." M. Pourcel and his colleagues then developed in France the production of iron-manganese alloys, very rich in manganese, by blast-furnace methods, and such indeed was the progress during the years 1875 to 1885, that even during this period the alloy was available with more than 80 per cent. of manganese and produced at a price so low as to constitute an adequate complement to the economic side of Bessemer's process. Our British iron-masters were not slow to follow, and manganese-iron alloys of a wide range of composition became suitably available, both in quality and tonnage, to meet the needs of the rapid increase in steel production.

We now come to consider a most important phase

of the manganese production. Whether the alloy was ferro-manganese with a very high percentage of manganese, or 'Spiegel' containing low percentages of manganese, it necessarily contained a high percentage of carbon, owing to the fact that it was produced in the blast furnace with coke as the reducing agent. Manganese alloys were not available except with a high carbon content, and the carbon ranged at so high a value as 4·0 to 7·0 per cent. This was fortunate as regards the Bessemer process, since that process consisted, in Britain, of blowing air through liquid crude iron until finally only very small quantities of the carbon, manganese, and silicon remained, and therefore it was just as necessary to add carbon as manganese before finally casting the steel. Since the manganese addition of the order of 1·0 to 2·0 per cent. remained constant, and the carbon of steel must vary according to the purpose to which it was to be put, it will be seen that by choosing suitable ratios of manganese and carbon in the manganese alloy the desired result was obtained.

As an interesting departure from the normal Bessemer process, it should be recorded that the Swedes developed an indigenous modification based on the use of crude iron rich in manganese, and that at the end of the blowing period, sufficient of the element remained in the iron to make additions unnecessary. Some of us had the pleasure of seeing this process in operation last autumn through the courtesy of our Swedish friends, and it was interesting to see how the retention of manganese in the liquid bath permitted a technical control of the blowing operation, since the blowing could be arrested, the composition of the bath determined and blowing proceeded with intermittently until the desired carbon content was attained. In considering the development of the early major steel processes, it should always be borne in mind that the physical chemistry of the reactions was even less completely mastered than at present, and that the whole of the development was necessarily accomplished by empirical methods. The achievements of the last century demand our appreciation.

Turning now to the discovery of manganese steel, Sir Robert Hadfield must have been a very young man when, in the early 'eighties of last century, the idea occurred to him of adding the manganese alloys then available in varying proportions to iron with the resultant production of a series of iron-carbon-manganese alloys, one of which proved to have astounding properties. It had previously been understood that if more than 2 or 3 per cent. of manganese was added to steel it became uselessly hard and brittle. Indeed, the whole of the experimental series produced by Sir Robert were very low in ductility in the as-cast condition, but his research was carried further, and by various experimental heat-treatments he discovered that in a range of composition, quenching in water from a high temperature produced alloys of great ductility, and other valuable characteristics. It will thus be seen that the discovery of manganese steel did not simply result from the melting of the materials in different proportions, but necessitated, in addition, a well-conceived research covering subsequent treatment.

'Manganese steel' is still produced to the original composition and treatment as determined as a result of the original researches. It contains 13 to 14 per cent. of manganese, and between 1·0 and 1·5 per cent. of carbon. In the water-toughened condition it has a tensile strength of 60 to 70 tons per square inch, accompanied by a ductility indicated by an elongation of 40 to 60 per cent. Although very tough, its wear resistance is remarkable, and this property has led to its manufacture in very large quantities. Its great ductility, accompanied by its high strength, led to the production of many millions of soldiers' helmets during the War, whilst its non-magnetic properties have found applications in many, and in some extremely curious, directions. It should, however, be borne in mind that this steel is a ternary alloy, *i.e.* it consists essentially of iron, manganese, and carbon, and, as Sir Robert points out in the second paper under consideration, his early discovery was facilitated by the high carbon content of the early manganese alloys, available at the time, resulting from their reduction in the blast furnace in the presence of an excess of carbon.

It always intrigued the minds of metallurgists as to what would be the properties of iron-manganese alloys of similar composition in the absence of carbon, but until comparatively recently it was only possible to approximate to the necessary experimental conditions, owing to the difficulty of obtaining 'carbonless' manganese. The efforts of many investigators have culminated in it now being possible to fulfil the conditions reasonably. Sir Robert Hadfield has been able to produce a series of iron-manganese alloys in which the manganese content varies from 1·68 to 83·5 per cent., with a carbon content not exceeding 0·20 per cent. until the manganese exceeds 39·0 per cent. Whilst not even yet quite fulfilling the desire to produce a series free from carbon, yet the carbon content is undoubtedly exceedingly low when it is borne in mind that sufficient of each alloy was produced to investigate the wide range of properties satisfactorily. It is instructive that Sir Robert was able to secure metallic manganese containing 99·52 per cent. of the element with only 0·11 per cent. of carbon. A survey of the results will show that comparison is now possible of the data to be obtained from a 13·0 per cent. manganese steel containing 0·09 per cent. of carbon, with the standard product, which contains approximately fifteen times that amount, that is, 1·4 per cent. The experiments indicate the necessity of the high carbon content for the essential wear-resisting property; that the non-magnetic properties can be achieved with the low carbon, but by considerably increasing the manganese content; but that the high strength and great ductility are impracticable, except with a substantial carbon content. The paper contains much data of value to the specialist, and although space prevents the writer doing so,

the author duly acknowledges the work of others in the same field with a thoroughness which is by no means invariably a noticeable feature in scientific papers.

Manganese has its applications in other branches of metallurgy, and its compounds have been applied industrially down the centuries, but enough has been written concerning its value to the key iron and steel industries to emphasise the importance of ensuring that, whether we be at peace with the world or not, our supplies must not be interrupted. W. H. H.

Lister's Methods in Surgery.[1]

By Sir W. WATSON CHEYNE, Bart., K.C.M.G., C.B., F.R.S.

IT is curious how events and discoveries fit into their proper place in the history of the world, and how one discovery may often dovetail into another and increase the usefulness of both. I have in my mind the discovery of anæsthesia and asepsis.

Anæsthesia alone was naturally a very great gain to mankind both in saving pain and in reducing shock, but in some respects it was a disadvantage. Before its introduction, the hall-marks of a good surgeon were rapidity in operating and thorough anatomical knowledge. The range of operative work, however, was not very great. But the fact that pain could be abolished and shock considerably reduced by anæsthetics had the effect of encouraging surgeons to perform more prolonged and intricate operations. The consequence was that, as sepsis was as frequent and as dangerous as before, this meant an increase in the number of cases of sepsis and in the mortality in the surgical wards; and surgeons became more doubtful than ever of the advisability of extending the area of surgery.

As soon, however, as Lister had firmly established his aseptic methods, this difficulty passed away; rapid and enormous extensions of the limits of surgery were introduced by him and his followers, and anæsthesia took a permanent and most important place in forwarding this.

The times were indeed ripe for the revolution made by Lister in the treatment of wounds. For ages, those who practised surgery were constantly confronted by the various septic diseases following wounds, whether made accidentally or by the surgeon. Occasionally, some one had a glimpse of the truth, but the wound treatment, whatever its nature was, had as its object the application of dressings and medicaments in order *to make the flesh heal*, as opposed to Lister's principle of *leaving the wound itself alone while striving to remove all agencies which might hinder the wound from healing*.

The cause of the septic troubles was for long looked on as connected with the admission of air to the wounds, and when oxygen was discovered, that gas was generally blamed for setting up changes in the blood and tissues. But towards the end of the eighteenth century, John Hunter pointed out that it could not be the gases in the air which caused harm, for in cases of emphysema and pneumothorax due to fracture of a rib and puncture of the lung, the tissues and the pleural cavity became distended with air; but neither sepsis nor suppuration supervened. Therefore Hunter was in favour of abolishing the masses of dressings which were most in vogue in those days, and contented himself with applying a piece of dry lint over the line of incision and encouraging drying of the lymph and blood—that is to say, healing by scabbing. His example was followed by others, who tried to aid scabbing still further by blowing warm air over the wound at frequent intervals, or by the use of powders, dusting the line of incision with them.

About the same time Abernethy advocated with considerable success the use of valvular incisions in removing loose bodies from joints and in opening psoas abscesses.

At the beginning of last century, subcutaneous surgery was introduced and Delpach elaborated it. Although its range of action was comparatively small, it still remains one of the important surgical methods of the day.

During last century a number of methods of treating wounds were introduced with a certain amount of improvement in results. Such methods were: open treatment, water dressing, immersion, water bath, irrigation, occlusion, etc. Just before Lister began his work, various substances, chiefly in solution, which belong to the class of antiseptics, *e.g.* coal tar, carbolic acid, iodine, hypochlorites, perchloride of iron, etc., were being tried, especially in France. Of these, carbolic acid was lauded by Lemaire, but these antiseptics were only used in septic wounds; and Lemaire and others missed Lister's great generalisations which were the basis of his work.

I may mention here Lister's 'slogans.'

1. Destroy the bacteria before they enter and establish themselves in the tissues.

2. Antiseptics are not used as applications to the tissues of the body laid open by the surgeon, but to the bacteria which are present everywhere, in the air and on the objects around.

3. Let as little as possible of the antiseptic enter the wound, but do not be unnecessarily afraid of it because, so long as the bacteria are kept out, any superficial damage done by the antiseptic will be rapidly repaired without any acute inflammation or suppuration.

4. The failure of the previous attempts with antiseptics was due to the fact that they were applied to wounds in which bacteria had already gained a footing and, as there is very little chance of eradicating the bacteria at that stage, irritating antiseptics like carbolic acid only make matters worse.

One would have thought that these principles

[1] From an address delivered at the Lister Centenary Celebrations at Edinburgh on July 20.

were clear and, when taken along with the published results, would have been very convincing. It always was a great puzzle to Lister's staff that surgeons did not rush to Lister's clinic to see his results and to learn his technique. True, there were always some foreigners, chiefly Germans and others of the Scandinavian races present in Edinburgh, but the number of British surgeons was very small indeed. Thus, when Lister migrated to London in 1877 (eleven years after his first publication), the number of London surgeons who were using his methods or were impressed by his teaching was extremely small and could probably be counted on the fingers of the hands.

It is not easy to account for this state of matters. Among other things it was very difficult to convince surgeons that tiny pieces of protoplasm about $\frac{1}{20,000}$ inch in diameter could be the cause of the septic diseases; the surgeons of that day were interested in keeping up their anatomy and in acquiring great rapidity in operating, and minute germs and processes of fermentation seemed very far removed from practical work; before Lister's time, carbolic acid and other chemicals had been applied to wounds without any benefit.

Lister's statement as to what he had achieved was so contrary to the experience of other surgeons that they felt that there must be a fallacy somewhere, and they were quite sure that the fault did not lie with them. They noted that Lister was constantly changing his technique and dressings, and came to the conclusion that this was because his results were not good. They apparently did not listen to his statements, that he did so with the object of reducing or removing the irritation of the antiseptic and at the same time simplifying his technique. They also pointed out that primary union of wounds was not a very uncommon occurrence before Lister's time, but they ignored his statement that it was the rule in his wards; they further pointed out the disagreeable effects of carbolic acid on the hands of the surgeon and its occasional poisonous effects.

In spite, however, of these and other objections which need not be recalled, Lister went on with his work. When he retired there was little to find fault with as regards irritation of the wounds or skin by the antiseptics, and sepsis had become a matter of the rarest occurrence when his methods were adhered to rigidly.

News and Views.

To the exhibition galleries of the British Museum (Natural History) have recently been added two exhibits of exceptional interest, both concerned with the elephant family but otherwise quite different. In the Palæontological Gallery has been erected the huge skeleton of the great fossil elephant which was brought to light by a party of Royal Engineers when digging practice trenches by the Medway opposite Chatham Dockyard about 1911. The importance of the bones that had been dug up was, however, not realised until 1913, when Mr. S. Turner sent some of the bones to the Natural History Museum for identification. Efforts were then made to secure the whole of the skeleton that remained, and Mr. L. E. Parsons, under the supervision of the late Dr. C. W. Andrews, spent several months at Upnor carefully excavating and packing the specimens for removal to the Museum. Further work was necessarily prevented by the War, and afterwards progress was gravely hindered by the death of Dr. Andrews. Fortunately, Mr. C. Forster Cooper, of Cambridge, a well-known authority on this group of fossils, lent his aid, and Dr. W. Rushton Parker generously defrayed the heavy cost of the ironwork fitting. Finally, in spite of the difficult times, money was found for the base and the rail, and at last, after fourteen years, the public are enabled to see the remains of this huge creature, which stood over 12 feet high.

THE other noteworthy new exhibit in the Natural History Museum is a habitat group of the South African elephant (*Elephas africanus capensis*), once widely distributed over South Africa but now nearly extinct. At the time of the destruction of the Addo Bush herd, the Union Government presented the Trustees with the skin and skull of an immature female and of a young male from the Addo Bush, and of an immature male from Knysna Forest. These three specimens, which were mounted in the Rowland Ward studios, compose the group, and the scene has been laid in the Knysna Forest because of its greater picturesqueness. The Union Government enhanced the value of the gift by the addition of timber —yellowwood (*Podocarpus elongata*) and ironwood (*Olea laurifolia*)—and vegetation—tree-fern (*Hemitelia capensis*), fern (*Aspidium capense*), palm (*Strelitzia augusta*), and "Tangles" (*Helichrysum*)—all carefully collected and packed by the Forestry Department. The Thesen and Union Castle Steamship Companies generously conveyed the material free of charge from Knysna Harbour to Cape Town and thence to London respectively. The exhibit has been designed and arranged by Capt. J. G. Dollman, and the lighting effects planned by Dr. G. F. Herbert Smith.

ON Thursday of this week, July 28, Sir William Thiselton-Dyer reached the age of eighty-four years, and his many friends rejoice to offer affectionate tribute to one who has done so much to promote and extend the plant resources of the British Empire. Nearly two years ago (Sept. 26, 1925) we published an appreciative article upon Sir William's work at the Royal Botanic Gardens, Kew, and its influence upon both pure and economic botany, and we are glad to know that its importance is widely recognised. He and Lady Thiselton-Dyer celebrated their golden wedding on June 23, and among the messages of congratulation were one from Mr. L. S. Amery, Secretary of State for the Colonies, and another from Prof. von Goebel, the doyen of German professors of botany. Mr. Amery referred appreciatively to Sir William's studies in the field of botanical enterprise,

by which he has "rendered such valuable services in all corners of the Empire," and Prof. von Goebel wrote: "It was you who first brought English and German botany into association which—serving as it does purely ideal aims—could not be destroyed by the War; and, further, we German botanists remember with gratitude the great services which you rendered with regard to Kew, with which in company with the two Hookers your name also will always be connected." It should be as encouraging to scientific workers generally as it is gratifying to Sir William Thiselton-Dyer to know that the seed of voluntary scientific service, such as was sown by him during many years, has borne rich fruits for the benefit of the human race, and that its value is understood in many lands.

INTERNATIONAL relations in the chemical industries figured prominently in the report of the Council of the Association of British Chemical Manufacturers, adopted at its eleventh annual general meeting on July 14. The chairman, Mr. C. A. Hill, declared that undoubted advantages, from an international point of view, would accrue from the existence of a firm of the size and importance of Imperial Chemical Industries, Ltd.; he referred also to the fact that the Association has joined the British National Committee of the International Chamber of Commerce, which has just held a conference in Stockholm, and to the conversations which have taken place between representatives of the Federation of British Industries and those of corresponding organisations in France, Germany, and Italy. These conferences, which are associated with the League of Nations Economic Conference at Geneva, afford an opportunity, which appears to have been effectively used, of securing to chemical industry in Great Britain a voice in the discussion of concrete matters of material concern, as well as of bringing it into closer touch with the trend of thought and outlook elsewhere. In speaking of domestic legislation, the chairman expressed relief that the proposed Factories (No. 2) Bill has been dropped; the much discussed 'petrol tax' which, however, is not proposed in the present budget, can scarcely exclude benzole, the taxation of which would have a disastrous effect on the dyestuffs section of chemical industry. References were also made to the effects of the Rating and Valuation Act 1925, the Merchandise Marks Act 1926, the Safeguarding of Industries Act, the Therapeutic Substances Act, and to Regulations concerning preservatives in food.

THE production of a monograph on the chemical industry of the world from the British point of view within ten days of the appearance at Geneva of a corresponding German publication was described by the vice-president of the Association of British Chemical Manufacturers, Mr. Perry, as a brilliant piece of work. In the discussion which ensued, Mr. T. Morson advocated the conferring of municipal franchise on corporations and companies, and spoke of the increasing cost of national social services, a subject which was further elaborated by the Right Hon. J. W. Wilson. Sir John Brunner, who gave an account of his recent visit to Berlin, said that the main discussions converged on restrictions on imports and exports; on the whole, there is a tendency in Germany to ask that such restrictions should everywhere cease. Tariffs were also examined from the point of view of classification and nomenclature; double taxation in Germany and England is another great hindrance to international trade. Fairs and exhibitions, it is generally felt, are overdone, and the opinion has been expressed that they are largely becoming a question of blackmail among the traders of various countries. Mr. F. H. Carr said that although the intention of the Therapeutic Substances Act is entirely benevolent, it may, if properly handled, do much to build up a branch of chemical industry which, whilst now in its infancy, has an immense future. Considerable satisfaction was expressed by Sir William Pearce in regard to the great improvement which has taken place in the position of the chemical industries since the end of the War.

THE University of Leyden has once more done honour to the Dutch physicians, biologists, and instrument-makers of the seventeenth and eighteenth centuries, by holding a special exhibition of their portraits and scientific instruments in the physical laboratory of the University on the occasion of the sixth Congress of the History of Medicine, held on July 18-23 in Leyden and Amsterdam. Drs. C. A. Crommelin, W. P. Jorissen, C. J. Van der Klaauw, and W. H. Van Seters have collaborated in producing a catalogue of the 139 objects exhibited in illustration of the work of 's Gravesande, the Munchenbroecks, Huygens, Leeuwenhoek, and Swammerdam. Two of the exhibits, two object glasses made by Constantijn Huygens, junior, and signed by him "C. Huygens, 10 May 1686, Ped. 122" and "C. Huygens, 19 Jun. 1686, Ped. 84," are of great interest, because they are accurately dated documents which, taken in conjunction with the three object glasses in the possession of the Royal Society of London, and dated June 4, June 26, and July 23, 1686, are evidence of the great industry and rapidity of working of the maker. We also note the reappearance of a quadrant made by J. M. Kleman for Boerhaave for use at his country house at Oud-Poelgeest. Although not stated in the catalogue, this quadrant, after being exhibited at Oxford in 1919, was given to the University of Leyden by the late Sir William Osler.

MM. PIERRE and Gérard Deffontaines record in *L'Anthropologie*, t. 37, Nos. 1-2, the discovery of a Tardenoisian station at Cape Blanc-Nez, a little to the east of the road from Sangatte to Escalles. It is situated on a mound or small hill of tertiary sands overlying the chalk which in effect is a western terminal of the Flanders hills, and is sharply differentiated from the surrounding country by the distinctive character of its vegetation. It affords another example of the close association of the Tardenoisian microlithic culture with a sandy heath-like country. The authors suggest that while the microlithic industry

might be appropriate here to a mode of life which depended upon proximity to the sea, the association with sandy soil might be due to the facilities it afforded in a light soil for the beginnings of agriculture. This, while possible, would scarcely seem probable, and it is far more likely that both the association with this type of ground and the small implements of the industry are due to the character of a population which from necessity or choice had turned its hunting activities to small game as well as to fishing.

IT has been decided to erect a monument at Lyons to the late Count Hilaire de Chardonnet, the 'Father' of the artificial silk industry. Chardonnet was born at Besançon on May 1, 1839, and died at Rome on Mar. 12, 1924. Educated at Besançon, where he studied chemistry under Prof. Loir, Pasteur's brother-in-law, he passed into the École Polytechnique at twenty years of age and afterwards devoted himself to scientific research. Many of his papers were read to the Paris Academy of Sciences. His first patent in connexion with the production of artificial silk, taken out on May 12, 1884—"Sur une matière textile artificielle ressemblant à la soie"—was the result of his investigations between 1878 and 1884. 'Chardonnet' silk was exhibited at the Paris Exhibition in 1889, a factory was erected at Besançon soon after, and in 1891, 12 tons of the new material was produced. For 1926 the world's production of artificial silk was estimated at 120,000 tons.

THE central place in the proposed plan of a thorough survey of the natural resources of Armenia is given (as stated in the *Information Bulletin* of the Russian Academy of Sciences, No. 7-8, 1927) to the investigations in the basin of Lake Goktcha or Sevang. It is suggested that the waters of this enormous mountain lake might be utilised for irrigating vast tracts of lands which cannot at present be cultivated; but this is connected with the possible lowering of the level of the lake itself, and thorough hydrological studies of the lake will be undertaken with this view. It is taken into account also that the scheme may result in some changes in the climate of the surrounding country, so that thorough climatic studies will be also made. The soils and vegetation of the lands proposed for irrigation will be studied by several field-parties in order to estimate definitely the agricultural value of the scheme. As the alteration in the regime of the lake cannot possibly be without its effects on its water fauna, a study of the latter, already in progress at the special hydrobiological station, will be continued on a larger scale and with the view of evolving a scientifically sound scheme of control of fisheries.

THE paper on modern tramway equipment read by A. V. Mason to the recent congress at Bath of the Tramways and Light Railways Association is of interest as showing the difficulties in the way of tramway companies and how they propose to get over them. Owing to the speed of motor-cars it is considered that 25 miles per hour is a suitable normal speed for tramcars. A modern tramcar takes 150 yards from rest before its speed reaches this value, and then nearly another 150 yards to come to rest, if violent changes of speed are to be avoided. It takes from 1½ to 2 minutes to unload 90 passengers from a tramcar. A motor omnibus is much more mobile. Everything to-day is being subordinated to speed. But speed needs power, and the starting current of modern tramcars is often more than 250 amperes, and this makes heavier supply mains necessary. On a day when skids are frequent the driver of a petrol vehicle goes slowly because he knows that the braking power is diminished. With a tramcar fitted with magnetic brakes, the driver runs at the same speed on all days as he knows by experience that the brake can always pull the car up quickly, and if the wheels skid they are released automatically. A recent improvement is to energise the magnetic brakes directly from the trolley wire. Unfortunately magnetic brakes tend to wear away the rails rapidly. When visiting Paris, Mr. Mason was impressed by the smooth running of the tramcars and the absence of all rattling noises. This is due to the brake being applied to a drum. In America the economic position is being straightened, wages have risen 120 per cent. on pre-War rates, and the fares have been increased 50 per cent. Successful experiments have been carried out on an all-aluminium car at Cleveland.

SINCE the arrival in India of a farmer Viceroy the subject of animal husbandry has received a new stimulus, as is witnessed by the publication of a new periodical, *The Journal of the Central Bureau for Animal Husbandry and Dairying in India*, Part 1 of which has recently been issued. It opens with a foreword by Lord Irwin himself, breathing that active interest in livestock which his career in Great Britain leads us to expect. "For the past two centuries," he says, "England's gentleman farmers have taken the lead in stock-breeding. . . . Let India's landed aristocracy follow their example"; and he rightly adds the reproof—"at present the tendency of the educated classes is to immerse themselves in politics or the law." The importance of the improvement of livestock in India cannot be exaggerated. A writer in the new journal estimates that the drain on the resources of the country caused by the enormous number of useless cattle maintained amounts to no less than 60 crores (upwards of 30 millions sterling annually). It is significant also to learn that although India is the country of the cow, the price of milk in Calcutta at the present time is 75 per cent. higher than the current retail price in London. The improvement of the yielding capacity of the Indian cow is an obvious line of attack; and it is gratifying to learn that already considerable progress has been made in this direction. We wish this new venture the success which the importance of its subject fully deserves.

THE most interesting of recent accessions to the Geological Department of the British Museum (Natural History) is a piece of rock from the immensely ancient Archæan rocks of Carelia, eastern Finland, presented

by the Director of the Finnish Geological Survey. This rock displays a peculiar structure closely resembling some of the structures of approximately the same age in North America that have been described by the late C. D. Walcott as fossil Algæ. It has therefore been named *Carelozoon jatulicum*, and is by some experts regarded as evidence of life millions of years before the oldest known undoubted fossils. Among recent purchases are a few hundredweight of rough chunks of rock from Nevada; these are filled with ammonites of Middle Triassic age, as well as a few bones of an ichthyosaur. The specimens will be carefully extracted in the workshops of the department. Mr. F. M. Mackwood has presented to the Department of Entomology of the Museum sixty boxes of butterflies and moths, collected by himself in Ceylon. Included in the thirteen boxes of butterflies is a number of rarities, while the forty-seven boxes of moths form a welcome addition to the extensive collections of Ceylon moths already preserved in the Museum.

AMONG the objects figured in the recent *Records of Additions* to the Hull Museum, is an example of a bronze palstave. This form of bronze age axe, in which the cutting edge is at right angles to the septum between the flanges for hafting, as was noted by Sir John Evans, is of particular rarity in England. The Hull Museum specimen was recently found at Messingham in Lincolnshire. It is 4½ inches long, the cutting edge is slightly more than 1½ inches in length, and the implement weighs 5 oz. Unlike the two figured by Sir John Evans, which were fairly straight in the shaft, it has a well-shaped semi-lunar cutting edge resembling an Irish example also figured by Sir John Evans.

A COMMITTEE representative of agricultural interests in the northern counties of Great Britain, and under the chairmanship of the Duke of Northumberland, has issued an appeal for a fund for a memorial to the late Prof. Douglas A. Gilchrist, who died on April 4 shortly after his retirement from the chair of agriculture at Armstrong College, Newcastle-on-Tyne. The memorial will probably consist of a scholarship at Armstrong College for post-graduate students in agricultural science, or, should the fund be insufficient, for the award of a prize or prizes to agricultural students. Contributions may be sent to the honorary secretary, Mr. C. Williams, The Moothall, Newcastle-upon-Tyne.

APPLICATIONS are being invited by the Institution of Civil Engineers until Sept. 16 for the Yarrow and William Lindley scholarships. Applicants for the Yarrow scholarships must be British subjects who are not more than twenty-three years of age and who, desiring to become engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The scholarships are ordinarily of values from £50-£100 per annum for one, two, or three years. Applicants for the William Lindley scholarships must not be more than twenty-three years of age, and must be children of corporate members of the Institution whose means are inadequate to defray all the expenses incidental to an engineering training. The fund provides for (*a*) a major scholarship of £80 per annum for engineering study at the University of Cambridge, tenable for three years, and (*b*) a scholarship of £40 per annum for scientific education or practical training in engineering.

THE Library of the Chemical Society will be closed for stocktaking from Monday, Aug. 1, until Saturday, Aug. 13 inclusive, and will close each evening at 5 o'clock on Aug. 15–Sept. 10.

BY arrangement with the London County Council, the Imperial Institute cinema will be open from 2.40 P.M. to 5.30 P.M. on Sundays for the free display of films relating to the life and industries of the Dominions, India, the Colonies and Protectorates. The cinema is open free on week-days from 10.30 A.M. to 12.30 P.M. and from 2.30 P.M. to 4.30 P.M.

MR. J. C. RICHARDSON, 74 Storemont Road, London, S.W.11, writes to say that quicklime which has been soaked in petroleum, in contact with a little water evolves so much heat that the oil is readily ignited. This effect was probably used in the ancient incendiary mixtures, since the "Liber ignium" (twelfth century MS.) describes the effect noticed by Mr. Richardson (*R. calcem vivam . . . cum oleo . . . aqua aspersa accendetur*).

THE Astronomer Royal has arranged for the supply of enlarged photographic prints of the fine picture of solar prominences and inner corona secured at Giggleswick during the total eclipse of the sun on July 29. The moon's disc on the picture is 7½ inches in diameter, and the structure of the prominences and corona is remarkably fine and clear on the print. Copies may be obtained, at the price of 2*s*. 6*d*. each, upon application to Mr. F. Jeffries, Royal Observatory, Greenwich, London, S.E.10.

ANOTHER of the important catalogues of second-hand science books (No. 409) of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, has just been circulated. As usual it gives particulars of many choice and rare volumes. The contents are arranged under the sections of botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued a very interesting and important catalogue (No. 150) of works on science published prior to 1800. It gives particulars of upwards of 400 volumes dealing with botany, horticulture, agriculture and herbals, general natural history, medicine, astronomy, mathematics, sundials, etc. Many of the works listed are extremely rare. The catalogue, which can be had upon application, is worthy of perusal.

ON every hand the development of scientific control brings in its train new methods of analysis and testing, and eventually convention crystallises into standardisation. Instrument makers must exert themselves to keep pace with the supply of the necessary equipment, and what this involves may be

seen from the catalogue dealing with the "Analysis of Coal and its By-Products," just issued by Baird and Tatlock (London), Ltd. It has 136 quarto pages, is illustrated, and seems to include more than most of those interested in fuel analysis are likely to require. Thoughtfully, the proposed standardised methods of coal analysis are included in summarised form, and also a variety of useful information, presumably to encourage us to look inside as often as possible. A catalogue of "Apparatus for Testing Petroleum Products" stocked by the same firm occupies 44 pages and covers the requirements of the tests of the Institution of Petroleum Technologists.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A temporary lecturer in agriculture under the Wilts County Council Agricultural Committee—The Organiser of Agricultural Education, Polebarn House, Trowbridge (Aug. 6). A junior assistant in the department of civil engineering of the Queen's University of Belfast—Prof. Hummel, The Queen's University, Belfast (Aug. 13). A director of the School of Egyptian Arts and Crafts, Cairo—The Under-Secretary of State, Ministry of Education, Cairo, Egypt (Aug. 15). An assistant lecturer in mathematics in the Bradford Technical College—The Principal, Bradford Technical College, Bradford (Aug. 23). An assistant woman lecturer and demonstrator in botany and an assistant woman demonstrator in physics at the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (Aug. 25). Three posts at the Royal Veterinary College, namely, a principal, a director of the Research Institute in Animal Pathology, and a professor of pathology—The Secretary, Royal Veterinary College, Camden Town, S.W.1 (Aug. 31). A professor of English language and literature in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, W.C.2 (Oct. 1). Two research scholars at the John Innes Horticultural Institution—one, a botanist, to work at genetic and cytological problems, and one, a chemist, to work at problems of migration and storage with the plant—The Director, John Innes Horticultural Institution, Merton, S.W.19. An assistant lecturer in physics in the University College of the South-West of England—The Registrar, University College of the South-West of England, Exeter. Evening lecturers at the Croydon Polytechnic for electrical generation and transmission, advanced building construction and quantity surveying—The Principal, Croydon Polytechnic, Scarbrook-Road, Croydon. A science master at the Leeds Grammar School—The Headmaster's Secretary, Grammar School, Leeds. A chief lecturer to take charge of the chemical department of the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. A junior assistant under the directorate of Metallurgical Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

RECENT MAGNETIC DISTURBANCE.—A considerable magnetic disturbance, lasting about 9 hours, was registered between July 21 and 22 at Greenwich and at Abinger, Surrey. The disturbance, which commenced suddenly at 21^h on July 21, reached its greatest intensity between 2^h and 5^h on the following morning and died away rapidly soon after 6^h. The excursion shown by the declination magnet amounted to fully one degree. The disturbance was also well shown by the vertical force magnetometer.

A superficial examination of the sun's disc showed no spots likely to be connected with this disturbance. At 21^h on July 21, there were three unimportant groups of spots at distances of 38° west, 7° east, and 48° east of the sun's central meridian. A large regular spot was a little way on the disc at a distance of 78° east of the central meridian. It is possible, however, that spectroscopic observations may come to hand as an indication of an usually active region on the sun not represented by a sunspot, and at the time placed somewhere in line with the earth.

THE PLANET JUPITER.—Mr. W. F. Denning writes : "This planet may now be well observed, as it rises at the end of July at 9^h 37^m P.M. G.M.T., and will shortly be in view throughout the night as it comes above the horizon four minutes earlier daily, and arrives at opposition on Sept. 22. Mr. F. Sargent, of the University of Durham Observatory, states, in a letter to me, that he obtained a good observation of the planet's markings on the night of July 18 with a $10\frac{1}{2}$-inch reflecting telescope. He says the Red Spot is really true to its name in colour, for it is a bright, brick red. It is quite an obvious, easy feature. By comparison with an observation by the Rev. T. E. R. Phillips on July 21, 1926, he found that the rotation period, during the past 12 months, was 9^h 55^m 37^s, whereas the previous 12 months gave 9^h 55^m 33^s, or 4 seconds less. The direct inference is that the motion of the object has recently undergone a considerable slackening in its rate of motion. Following the Red Spot there is a distinct prolongation of the south-temperate belt which bends northwards towards the south margin of the south equatorial belt. Mr. Sargent observed several dark and white spots on the margin of the north equatorial belt and states that according to his estimates the length of the Red Spot is now only 20°, but one boundary of the marking appears to be indefinite. Forty or fifty years ago the length of the spot was about 32°."

A DISCUSSION OF STELLAR VARIABILITY.—Prof. C. D. Perrine contributes a discussion on this subject to *Astr. Nach.* No. 5505. His argument is that all types of stellar variation are due to a common cause which he takes to be pulsation of the type now generally assumed to explain Cepheid variables. It is rather curious that Prof. Perrine for a long time upheld the binary character of the Cepheids ; in abandoning this explanation for these variables, he also abandons it for stars where it seems to be well established. For example, the duplicity of Capella was confirmed by the interferometer, and the eclipse explanation of Algol's light changes was confirmed by the fact that the rotation of the principal star could be measured by the Doppler effect (the two limbs being successively under observation). The results fitted in harmoniously with the binary hypothesis.

Prof. Perrine reaches his conclusion by grouping all the known variables by period and light-range and showing that they lie along continuous curves, each type filling up gaps left by the others. Probably few will adopt his new conclusions in their entirety, but statistical discussions of this kind are always of value, and afford material for further study.

Research Items.

SKELETAL RECORDS OF MORTALITY.—An investigation in which the method is at least as interesting as the results, is recorded by Prof. T. Wingate Todd in the *Scientific Monthly* for June. Since 1912 the anatomical laboratory of Western Reserve University has preserved the skeletons of all subjects, of both white and negro stock, delivered to the medical school, together with a record of the age of each individual. An intensive study of this material, now 1400 specimens, with the view of determining appearances related to age, has made it possible to fix more accurately than hitherto the age at which death took place in any individual case, by an examination of the skeleton. It thus becomes possible, by applying this method to the study of skeletal remains for which a record of the age of death is not available, to determine with approximate accuracy the incidence of mortality. For the present investigation an examination has been made of the material already mentioned in the Medical School, West African skulls in the Royal College of Surgeons, the Tasmanian skulls in the same collection, bronze age skeletons from Furness, medieval remains from Scarborough, and skeletal material ranging in date from A.D. 800 to A.D. 1000 from Pecos in New Mexico. Data for Rome and the Roman colonies in Africa and Spain for comparative purposes are taken from Macdonell's study of expectation of life in Rome, which was based upon the epitaphs of the "Corpus Inscriptionum Latinarum" of the Berlin Academy. In each case interesting results emerge, but the general conclusion is perhaps most significant. The data relating to primitive and early races alike fail to show the peak of death in senility which Pearson found in the mortality curve for England. The peak of mortality occurs at a moderately early age. The peak of old-age death is therefore a comparatively modern achievement resulting from greater safety and improved conditions of living. It differs from the peak of mortality in early and primitive peoples by roughly thirty years.

ANTHROPOMETRY OF NORTH AMERICAN INDIANS.—A continuation of Dr. Aleš Hrdlička's catalogue of human crania in the United States National Museum has been published as vol. 69, art. 5 of the *Proceedings* of the Museum. This part is the second to be issued, the first having appeared in 1924 as art. 12 of vol. 63. It covers: Algonkin and related Iroquois (563 crania), Siouan (285 crania), the Caddoes (15 crania), the Salish and Sahaptin (15 crania), the Shoshonean (69 crania), and the Californians (403 crania). In addition the author's records of crania in other institutions have been added. Of the different strains, the Algonkin shows almost throughout a distinct physical character, coinciding almost exactly with the linguistic family; while the Iroquois, though of different linguistic stock, and including some heterogeneous elements, are radically of the same physical type—dolichocephalic to mesocephalic, with high vault, medium to large face, medium to low orbits, and medium to relatively narrow nose. The Sioux type, one of the best differentiated on the continent, has a mesocephalic skull of moderate to good size, a remarkably low vault—met with only in Athapascans and north-west coast tribes, and distantly among the Mongols—large face and jaws, medium to high orbits, and is mesorhine. The Californian tribes show considerable uniformity, are practically identical with the Shoshonean, and exhibit no traces of extraneous (non-Indian) influence.

THE THAMES AND THE RHINE.—The belief that the Thames and other English rivers were once tributaries of the Rhine and that the combined rivers flowed northward to the Arctic Ocean over a plain now occupied by the North Sea, has long been accepted. Jukes Browne put the Arctic outlet north of the Shetlands; Clement Reid put it nearer the Humber; and there have been other modifications in detail. Prof. J. W. Gregory re-examines the problem in an article in the *Geographical Journal* for July, bringing new evidence from the fauna of the rivers and the hydrography of the North Sea. His paper is full of detail and can only be followed with the help of its maps, but the conclusion at which Prof. Gregory arrives is that the Thames did not join the Rhine but turned south through the Dover gate and west along the course of the present English channel, joined by the Hampshire rivers and the Seine. The Rhine flowed through the Zuyder Zee and was separated from the Thames by a land barrier in the North Sea plain now recognisable as a rise on the sea floor, which Prof. Gregory terms the Haisboro-Terschelling rise. The rivers of the Wash and Humber probably joined the Rhine, which flowed westward of the Dogger Bank into the sea and possibly continued to the Norwegian trench. In either case, it would not have been connected with the rivers of Scotland. It is suggested that the land extended northwards only to the 40-fathom and not the 100-fathom line.

AUSTRALIAN AGRICULTURAL RESEARCH.—F. L. McDougall and A. S. Fitzpatrick, in Vol. 10, No. 2, of the *Scottish Journal of Agriculture*, give an account of agricultural research in Australia. The problems of the country are extremely diverse on account of the wide range in the climatic conditions and the variety of industries which are therefore possible. Both agricultural and pastoral industries have increased enormously in the last few years, but as hitherto farming has been on an extensive rather than intensive scale, and as only a small proportion of workable land is actually under cultivation, the scope for future development is large. The chief industry is wool production, and attention to sheep breeding on scientific lines has resulted in a striking increase in the yield of wool; for example, the average weight of fleece per sheep in 1850 was less than 4 lb., whereas in 1925 it averaged 7·69 lb. Wheat growing is the second important industry. Improvements in plant breeding and better methods of dry farming have considerably extended the wheat belt, and the possible wheat-growing area is now estimated at double that at present bearing that crop. Fruit affords many specialised problems. Besides investigations on diseases and insect pests, the suitability of various soils for irrigation and the study of the effect of green manuring on soil fertility are two of the more important lines of work. The biological control of serious weeds, such as the prickly pear, by means of the introduction of certain insects, seems to be proving entirely successful. Dairying, another important industry, can be carried on throughout almost the entire country; similar problems can, therefore, be studied under widely varying climatic conditions. Deficiency in the mineral content of pastures is thought to have a possible correlation with a number of animal diseases, and owing to the importance of the meat export trade the question is being thoroughly investigated. Research is being conducted under two organisations working in close collaboration, namely, the Commonwealth Council for Scientific and Industrial Research, which deals with the scientific aspects of the industries, and the Development and Migration Commission, which is concerned with the economic conditions of the country.

THE LIMBS OF CRUSTACEA AND TRILOBITES.—In their recent paper on the feeding mechanism of a mysid (*Trans. R. Soc. Edin.* vol. 55, 1927) Prof. H. G. Cannon and Miss S. M. Manton criticise Storch's views on the evolution of the feeding limbs of the Crustacea and Trilobites. While Storch considers the primitive crustacean feeding limb to have been a phyllopodium similar to that of the Anostraca, and to have functioned essentially as a filtering mechanism, they suggest that the primitive limb was a biramous paddle such as occurs in the posterior trunk segments of Lepidocaris. From primitive articulates possessing biramous limbs the authors consider that the Branchiopoda and other Crustacea evolved from forms in which the limbs projected ventrally from the body in two parallel series, while Marella and the Trilobites arose from forms in which the limbs projected laterally. Among the Crustacea the endopodite became a foliaceous swimming organ in the Branchiopoda, while in the Malacostraca the exopodite developed as the swimming part of the limb, but it became whiplike. In Marella and the Trilobites the exopodite became the swimming branch of the limb. The authors agree with the usually accepted homologies of the two branches of the limbs of Trilobites; they do not accept the suggestion of Storch for the 'reversal' of the endopodite and exopodite.

A BURROWING CIRRIPEDE.—Major R. B. Seymour Sewell (*Records Indian Mus.*, **28**, pp. 269-330, 1926) has made a detailed study of *Lithotrya nicobarica*, a cirripede which burrows in coral or coral conglomerate usually in such a position that the head, or capitellum, hangs vertically downwards. The author obtained in the Nicobar Islands 65 examples of this species—the largest series hitherto obtained, and was therefore able to study the range of variation. The specimens were found to fall into four groups, which he believes to represent age-groups each corresponding to a year's growth. It would appear that the average length of life of the members of this species is about three years, but that a certain number of individuals may survive for a fourth year. Major Sewell gives a detailed description of the external characters, including the appendages, and of the alimentary tract; the nervous system, and the reproductive apparatus. All the species of Lithotrya appear to be hermaphrodite and are probably protandrous; no complemental or parasitic males have been observed in this genus. A consideration of the changes that occur in individuals of *L. nicobarica* as age and size increase suggests that several so-called species, which have hitherto been regarded as distinct, are merely different varieties or life-phases of a single widely distributed species. The author records a distinct tendency towards 'right-handedness' in the capitellum indicated by the fact that the scales or laminæ of both scutum and tergum are rubbed off to a greater degree on the right side than on the left. The greater development of the longitudinal peduncular muscles on the right side would seem to be associated with the 'right-handedness' since the more violent movement of this side of the body would cause a more rapid removal of the older laminæ.

MARINE SHELLS FROM THE SOUTH-EAST COAST OF THE UNITED STATES.—In 1885 and 1886 the U.S. Fisheries Steamer *Albatross* made a series of dredgings off the south-east coast of the United States. The larger specimens of mollusca have been already dealt with, but the examples from the fine siftings were reserved and worked at from time to time, as opportunity served, by the late Dr. W. H. Dall, the Pyramidellidæ being determined by Dr. P. Bartsch. The descriptions of these are now published (*Proc. U.S. Nat. Mus.*, vol. 70, art. 18) and account for 337 species, of which 204 are apparently new. Unfortunately, none of these new forms is at present figured.

HEREDITARY OBESITY IN MICE.—It is well known that in mice, yellow is epistatic to other coat colours and that homozygous yellow mice do not occur owing to the lethal effect of the yellow gene in the homozygous condition. Dr. Danforth has recently shown (*Jour. of Heredity*, vol. 18, No. 4) that healthy yellow mice always become abnormally fat on an ordinary diet, this tendency being even more marked in the females than in the males. Thus yellow females are often twice, and sometimes thrice, as heavy as others. The fat is partly subcutaneous and partly attached to the viscera. The evidence indicates that the obesity is produced by the same gene which produces the yellow coat pigmentation and not by a separate factor, since no cross-overs appear. On a restricted diet the yellow mice can gradually use up their store of fat, and it is suggested that the condition is similar to that in hibernating animals which store up fat in their tissues to be used later when no food is taken. The condition is also compared with that in certain human families with a pronounced hereditary tendency to adiposity.

THE ARMENIAN EARTHQUAKE OF OCT. 22, 1926.—This destructive earthquake is described in a brief report by Prof. S. Abdalian of the University of Erivan (*La Nature*, July 1). The epicentre was near Panyantour in the recently depressed valley of the Chirak. Several important faults traverse this valley, one of them running close to the volcano Alaghöz (about 15,000 feet in height). In the epicentral district the ground was much fissured, and in one fissure, passing through the village of Alexandrooka, a change of level of 15 mm. has occurred, the side next the valley being depressed with reference to the side of Alaghöz. At Dharli and Kazarabad, monuments in the cemeteries were rotated on their pedestals through an angle of 43°.

ICE ON THE COAST OF FINLAND.—The distribution of ice on the Finnish coast of the Gulf of Bothnia, the Gulf of Finland, and Lake Ladoga, year by year, is recorded in a series of papers published by the Havsforskningsinstitutet of Helsingfors, entitled *Översikt av Isaona*. They cover the winters 1914–15, 1915–16, 1917–18, 1919–1920, 1924–25. Reports for the other years have already been published. In a series of maps the nature and distribution of the ice is shown during the winter months. Freezing generally begins in November, and the ice has its widest extent in March; in April conditions improve, but the break up and disappearance of the ice is slow. Some of it may be present so late as June, but as a rule it has gone before the end of May. In some years January and February are little better than March. The data on which the distribution charts are based are collected by some seventy stations along the coast and in the Åland Islands. The reports also give the air and water temperature for representative stations during the winter months.

HYDROGRAPHY OF THE LABRADOR BANKS.—The report for 1926 of the International Ice Observation and Ice Patrol in the North Atlantic (*United States Coast Guard Bulletin*, No. 15) gives an account of some oceanographical researches in addition to the itineraries of the patrol vessels and location of the icebergs. The observations for 1926 corroborate earlier ones to the effect that the density of water on the Grand Bank is usually higher along the zone of contact between

the Labrador Current and the Gulf Stream than on either side of the Gulf Stream. But this high density does not exactly coincide with the abrupt transition from low to high temperature, but lies as a rule 25 miles to 35 miles inshore of it. Since the density wall unquestionably marks the easterly and the westerly sets of the Currents, it follows that the drop in temperature of the surface water does not mark the change in direction of the current. Another section gives a summary of iceberg records off Newfoundland between 1880 and 1926, with particular reference to the past twenty-six years, the records of which are plotted on a chart. It is shown that there are no ice-free months on the steamer tracks via Cape Race and only four on the tracks between the United States and Europe.

MOLECULAR SPECTRA.—The band spectra of the vapours of sulphur, selenium, and tellurium, which were the subject of a recent paper by Prof. McLennan in the *Philosophical Magazine*, have been examined in more detail by B. Rosen in Berlin (*Zeitschrift für Physik*, **43**, p. 69). The resonance series and the fluorescence and absorption spectra are similar to those found in iodine by Prof. R. W. Wood, and are likewise ascribed to a simple diatomic molecule. Addition of inert gases to tellurium does not, however, increase the number of lines obtained in resonance, as it does with iodine, but merely reduces the intensity of those already present. The analysis of these spectra gives considerable information about the forces between the two nuclei and the heat of dissociation into atoms, as well as the conditions under which Stokes's rule, that the excited light is of greater wave-length than the incident light, breaks down.

THE LIGHT FROM POSITIVE RAYS.—Prof. W. Wien has recently succeeded in photographing the first five members of the fundamental Lyman series of hydrogen in the ultra-violet light from positive rays which had passed through a perforated cathode (*Annalen der Physik*, vol. 83, p. 1). His usual technique had to be considerably modified, the pencil of positive rays being shot excentrically into the barrel of a vacuum spectrograph, where its image was thrown directly by the grating on to a Schumann plate. The calibration of the plate for quantitative measurements of intensity was effected by intercepting part of the positive rays, and measuring the current carried by the remainder to a small metal disc, the corresponding spectra being examined afterwards by ordinary photometric methods. Prof. Wien's photographs show very clearly the decrease in the luminosity of the beam as it passes away from the cathode. H_a and H_b have the same decay constant, and the failure of the classical theory of radiation from accelerated electrons is again demonstrated by the incorrect relation which it predicts between the damping factors in this case, and in the allied Balmer series. The grating used by Prof. Wien was ruled at the National Physical Laboratory, Teddington, on a blank supplied by Messrs. Adam Hilger.

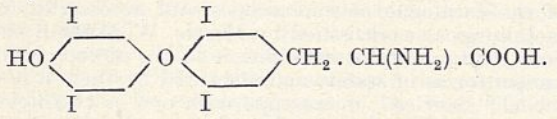
PROPERTIES OF METALS AT HIGH TEMPERATURES.—Part of a research carried out at the National Physical Laboratory by Messrs. Tapsell and Clenshaw on this subject is published in a pamphlet issued by H.M. Stationery Office, price 1*s.* 9*d.* Three metals are discussed: Armco iron and two steels with 0·17 and 0·24 per cent. carbon respectively. All the more important mechanical properties have been measured up to about 600° or 700° C. Although there is no fundamentally new result, the values which have been determined for the creep and fatigue strengths at these temperatures will be examined with care by those engineers to whom the strength of steel at high temperatures is becoming of immediate importance. So far as the limiting creep strength is concerned there is a progressive fall as the temperature is raised, for the mild steels from about 35 tons per sq. in. at 250° C. to 5 tons at 500° C. The fatigue strength falls slightly as the temperature rises above the normal to a minimum at 150° C., from ± 13 to ± 12 tons per sq. in., then rises rapidly to $\pm 17{\cdot}5$ tons per sq. in. at about 450° C., and afterwards falls off to ± 7 tons per sq. in. at 600° C., the highest temperature used. There are many useful tables of test data and curves and a continuation of the work will be looked forward to with keen interest.

METALLURGICAL MICROSCOPES.—The latest edition of the catalogue of microscopes and accessories for metallurgical work issued by Messrs. W. Watson and Sons, Ltd., contains in addition to the already well-known forms of stands manufactured by them a new model "Service" microscope with one or two novel features. Most noteworthy of these is the stage, which may be swung out so that the stand may be used to examine large metallurgical samples too heavy to be placed on the stage. For ordinary works' use this model would appear to be eminently suitable. A form of microscope designed in conjunction with Messrs. Vickers, Ltd., for industrial use is illustrated and should appeal to those carrying out routine work of a high order. A projection cabinet designed by Mr. E. A. Atkins for demonstration and similar purposes is shown, and, where foremen and others are given some idea of microstructures, this would seem to be a piece of apparatus admirably suited to its purpose.

THE THOMAS GAS METER.—This meter, made by the Cambridge Instrument Co., Ltd., and designed primarily for the accurate measurement of industrial or towns' gas, in terms of standard cubic feet of moist gas measured at standard temperature (60° F.) and standard pressure (30 inches of mercury) utilises the fact that the specific heat per unit volume of such gases is practically constant throughout the variations of pressure, temperature, density, and composition which occur in gas practice. The stream of gas flowing past an electric heater inserted in the gas main is heated exactly through 2° F., the difference of temperature being determined by two platinum thermometers inserted one on either side of the heater and forming two arms of a Wheatstone bridge. Under these conditions the energy input to the heater, measured on a wattmeter, is an accurate measure of the rate of flow of gas in the main. In order to maintain the bridge in balance with the two thermometers differing by 2° F., a third compensating thermometer, having a resistance equal to the difference of the first two, is inserted in the appropriate arm of the bridge. This temperature - difference thermometer also corrects automatically for variations of the water vapour content of the gas. Throughout, with varying flow, the bridge is maintained balanced and the energy input necessary to maintain the 2° F. difference of temperature varied automatically and recorded by an integrating wattmeter. If the gas flow ceases the meter is automatically put out of action. The meter is made in two standard forms—the return flow type, in which the meter is jacketted by the gas; and the vertical type, in which the meter is jacketted by a dead space containing gas. There are fourteen standard sizes, having maximum capacities ranging from 25,000 cubic feet per hour upwards. About 300 meters of this type are in use in various parts of the world.

The Constitution and Synthesis of Thyroxine.

ABOUT a year ago we referred to the work of Harington on the isolation of the active principle of the thyroid gland and the constitution and synthesis of its first degradation product, desiodo-thyroxine (NATURE, July 10, 1926, vol. 118, p. 65). A recent paper by Harington and Barger now completes this important piece of work by proving the constitution of thyroxine itself and describing a method for its synthesis (C. R. Harington and G. Barger, *Biochem. Journ.*, 1927, vol. 21, p. 169). The formula for the compound, as suggested by the previous work and proved in the present research, shows that it is a tetra-iodo derivative of the *p*-hydroxyphenyl ether of tyrosine:



Previous work had proved the constitution of desiodothyroxin and its synthesis had been accomplished: the problem remaining was the position of the four iodine atoms in the molecule and their insertion by synthesis. Three considerations made it appear probable that the iodine atoms occupied the positions given in the above formula: first, on fusing thyroxine with potash at a high temperature in the absence of oxygen, products were obtained exhibiting pyrogallol reactions, suggesting the presence of 3 : 4 : 5 trihydroxy benzene derivatives; secondly, nitrous acid and ammonia gave a colour reaction characteristic of benzene derivatives containing two iodine atoms in the *ortho* position to a hydroxyl or amino group; thirdly, on general grounds it appears probable that thyroxine is synthesised in Nature from tyrosine, through the coupling of two molecules of 3 : 5 diiodotyrosine with the loss of one side-chain.

Direct iodination of desiodothyroxine resulted in the uptake of two iodine atoms only, so that the introduction of the other two had to be effected before the phenylether synthesis was carried out. Several attempts were made to effect the synthesis, from compounds containing two iodine atoms or other easily replaceable groups in the required positions, of the body $CH_3O . C_6H_2I_2 . O . C_6H_2I_2 . COOH$ obtained by the methylation and subsequent oxidation of thyroxine, but without success.

Finally, however, a method was worked out, and the synthetic formation of this methylated oxidation product of thyroxine definitely proved the constitution of the latter. Quinol monomethyl ether was condensed with 3 : 4 : 5 triiodonitrobenzene, to give 3 : 5 diiodo – 4 – (4′ methoxyphenoxy) nitrobenzene: $CH_3O . C_6H_4 . O . C_6H_2I_2 . NO_2$ (the NO_2 group having a powerful mobilising effect on the halogen atom in the *para* position). This compound was then reduced to the aniline and the latter converted, by Sandmeyer's reaction, into the nitrile. The nitrile, boiled with hydriodic and acetic acids underwent simultaneous demethylation and hydrolysis, yielding the compound: $HO . C_6H_4 . O . C_6H_2I_2 . COOH$; on addition of iodine in potassium iodide to a solution of the acid in concentrated ammonia, iodine was rapidly taken up, the uptake ceasing abruptly at two molecules. On methylation an acid, identical in every respect with that obtained by the methylation and oxidation of thyroxine, was produced. These experiments thus settled the orientation of the iodine atoms in thyroxine, since the last two, introduced in alkaline solution, must have entered the *ortho* positions to the free phenolic group.

For the actual synthesis of thyroxine the starting-point was 3 : 5 diiodo-4-(4′ methoxyphenoxy) benzaldehyde; but it could not be condensed directly with α-aminopropionic acid, since the necessary reduction would displace the iodine atoms. Some success was attained by condensing it with hydantoin, but far better results were seen when hippuric acid was used. The resulting compound

$$CH_3O . C_6H_4 . O . C_6H_2I_2 . CH : (C_3O_2N) : C_6H_5$$

was then converted into the α-benzoylamino cinnamic ester:

$$CH_3O . C_6H_4 . O . C_6H_2I_2 . CH : C(NH . CO . C_6H_5)COOEt,$$

which, on boiling with hydriodic acid and red phosphorus, underwent demethylation and conversion of the side-chain into α-aminopropionic acid. The final stage of iodination in ammoniacal solution led to the uptake of two iodine atoms and the production of a compound identical in its chemical and physiological properties with natural thyroxine.

These two syntheses, then, establish finally the constitution of thyroxine. That the synthetic product has the same physiological properties as that isolated from the thyroid gland is shown in an appendix by D. M. Lyon: the basal metabolic rate of two cases of myxœdema was raised from about – 40 per cent. to normal in the course of a week by three or four intravenous injections of 4-5 mgm. of the synthetic product on alternate days. These effects are quantitatively similar to those reported for natural thyroxine.

There can be no doubt, then, as to the identity of the artificial and natural thyroxines, and we can congratulate the authors on bringing their research to a successful conclusion.

The Cockle Industry in Great Britain.

OUR knowledge of the edible shellfish of British coasts has been extended by Mr. F. S. Wright in his "Report on the Cockle Beds and the Cockle Industry of England and Wales" (*Fishery Investigations*, Series 2, Vol. 9, No. 5, 1926. London: H.M. Stationery Office. 3*s.* net). Not only are his own investigations on the habits, bionomics, and growth of cockles of great value, but he has also done a great service by bringing together a mass of information on the subject which has hitherto been very scattered.

The economic value of the cockle is considerable, and its potential value even greater. Under the best conditions, when living in wet stable sand, cockles occur in vast numbers in comparatively small areas. Mr. Wright estimated that in one bed in the Llanrhidian Sands in South Wales, having an area of some 320 acres, there were present about four hundred and sixty-two million cockles of all sizes, the average number in each square metre being 357. A very interesting point brought out in the paper is that in some localities there are definite beds of young cockles which contain a dense population. As the cockles grow, many are forced to the surface, and these are then distributed over the general surface of the beds by the action of waves and currents. Though the enemies of the cockle include starfish, boring gastropods, gulls, and certain fish, the greatest danger to the beds comes from frost, storms, and currents, which may destroy great numbers of cockles in the winter months. The cockle gatherers themselves do

great damage with their rakes, and by leaving the young cockles which are too small for the market at the mercy of currents instead of scattering them over the beds where they can re-establish themselves. By so doing they endanger their own livelihood as well as contravene the by-laws which regulate the cockle fisheries.

The chief centres of the cockle fishery in England and Wales are the Wash, the Thames Estuary, Carmarthen Bay, and Morecambe Bay. The cockles are gathered by raking, scraping, and digging, and are usually boiled, and the soft parts separated from the shells by sieving, before they are sent away to the market. The shells have a certain value, for they are often ground up to serve as grit for poultry.

Although it has not the high carbohydrate content of the native oyster, the food value of the cockle is considerable, and, in common with similar shellfish, it provides a valuable source of food the use of which might with great profit to the community be greatly extended. It is encouraging in this connexion to note that the annual quantity of cockles landed in Great Britain increased from 167,089 cwt. in 1923 to 300,721 cwt. in 1925, while probably many more were collected by casual gatherers. It is disconcerting, however, to learn that owing to the fact that English gatherers often refuse to take the trouble to pick out the larger cockles, which naturally command the best market, considerable quantities of cockles have been imported from Holland, where, apparently, the shellfish merchants pay more attention to the market.

C. M. Y.

River Pollution and Fisheries.

DR. H. C. REDEKE has written a useful summary of the results of recent investigations upon the subject of river pollution for the International Council for the Exploration of the Sea (*Rapports et Procès-Verbaux des Réunions*, vol. 43, May. Copenhagen: Andr. Fred. Høst et Fils, 1927). The direct influence upon fishes of sewage and of trade wastes containing organic matter or inorganic poisons, is discussed, and the methods used in treating the various pollutions on the Continent, in America, and in Great Britain are outlined. The report contains a comprehensive bibliography.

The disposal of noxious effluents is urgent in England, perhaps more so than on the Continent, where as a rule the towns have rivers carrying a greater quantity of water into which to discharge. As pointed out by Dr. Redeke, the capacity of the rivers for self-purification allows the discharge of effluents up to a certain concentration without material damage to the fisheries.

Waste products containing organic matter, such as domestic sewage, the wastes from sugar beet, milk, or paper factories, abattoirs, etc., require treatment before reaching the rivers by allowing a natural fauna and flora of micro-organisms to act upon them for a sufficient length of time, usually under aerobic conditions, and the removal of solid matter, whereby their putrescibility is reduced. The problems of domestic sewage disposal have been solved on these lines in a very satisfactory manner on the whole; less attention has been paid to the analogous problems presented by trade wastes where, although similar methods are reported to give satisfactory effluents, the expense of installations or area of land required has militated against their general adoption.

Trade wastes containing inorganic poisons (gasworks, coke oven, artificial silk factory effluents) or inorganic poisons and organic matter (leather, paper, textile and glue trade effluents), each require particular treatment. Small volumes of highly polluting wastes can generally be got rid of by allowing them to seep through a sufficient amount of soil before entering any watercourse, but with large quantities the expense of treatment is the major problem.

In discussing to what extent pollutions will be injurious to fisheries, Dr. Redeke lays stress upon the extent to which an effluent will be diluted on entering a river, and concludes that the degree of purity of an effluent which should be aimed at depends upon such local circumstances; the discharge of substances directly poisonous to lower animals and plants should be prohibited, for these destroy the capacity of the stream for self-purification from organic wastes.

University and Educational Intelligence.

ABERYSTWYTH.—At a recent meeting of the Court of the University of Wales, it was announced that an anonymous donor has given a sum of £10,000 for the encouragement of research.

CAMBRIDGE.—Mr. J. A. Venn has been elected to a fellowship at Queens' College. H. Barcroft, King's College, has been elected to the Michael Foster studentship in physiology.

EDINBURGH.—At the meeting of the University Court on July 18, a letter was received from Prof. J. Cossar Ewart intimating his resignation from the chair of natural history. The Court accepted the intimation with very great regret, and expressed appreciation of the eminent services which Prof. Cossar Ewart has rendered to the University during his long and distinguished tenure of the chair, to which he was appointed in 1882.

On his retirement as physician to the Royal Infirmary Prof. G. Lovell Gulland intimated his resignation from the chair of medicine. The Court accepted the intimation with much regret, and resolved to record its grateful sense of the value to the University of Prof. Gulland's work as a teacher and physician.

The Court approved the terms of an ordinance founding the Buchanan chair of animal genetics, and directed that it be transmitted to the Privy Council and to the other Scottish universities. The foundation of this chair is part of the scheme for setting up a new and enlarged University Department of Research in Animal Breeding. The endowment consists of £20,000, half of which was contributed by Lord Woolavington, and half by the International Education Board of New York.

At a meeting of the Curators of Patronage of the University on July 21, Prof. J. H. Ashworth, professor of zoology in the University, was unanimously appointed professor of natural history, as from Oct. 1, in succession to Prof. J. Cossar Ewart.

LONDON.—Dr. D. L. Mackinnon has been appointed as from Aug. 1 to the University chair of zoology tenable at King's College. Since 1919 Miss Mackinnon has been senior lecturer in zoology at King's College, and in 1921 the title of reader in zoology was conferred upon her. In addition to numerous papers in scientific journals, she has translated into English von Uexküll's "Theoretische Biologie" (Kegan Paul's International Library of Psychology, Philosophy, and Scientific Method, 1926), and has edited the translation from the Russian of Berg's "Nomogenesis" (Constable, 1926).

Prof. E. H. Kettle has been appointed as from October to the University chair of pathology tenable at St. Bartholomew's Hospital Medical College. Since

1924 Prof. Kettle has been professor of pathology and bacteriology in the Welsh National School of Medicine, Cardiff. His published work includes the following: "The Pathology of Tumors" (Lewis and Co., 1st ed., 1916, 2nd ed., 1925) and numerous articles in the *Journal of Pathology and Bacteriology*, the *Lancet*, and other medical journals.

Dr. Bronislaw Malinowski has been appointed as from August to the University chair of anthropology tenable at the London School of Economics. He has been University reader in social anthropology since 1923. He is the author of "Crime and Custom in Savage Society" (Kegan Paul, 1926); "Myth in Primitive Psychology" (Kegan Paul, 1926); "The Father in Primitive Psychology" (Kegan Paul, 1927); "Sex and Repression in Savage Society" (Kegan Paul, 1927); and of articles in "The Encyclopædia Britannica" (1926), "The Australia Encyclopædia" (1926), NATURE, *Psyche*, *Zeitschrift für Völkerpsychologie*, and other journals.

Dr. W. H. Linnell has been appointed as from Aug. 1 to the University readership in pharmaceutical chemistry tenable at the School of Pharmacy. From 1924 until 1926 Dr. Linnell was an organic research chemist at H.M. Fuel Research Station, and since October 1926 he has been lecturer in pharmaceutical chemistry and Director of the Chemical Research Laboratories in the School of Pharmacy.

OXFORD.—The following elections to University scholarships on the Theodore Williams foundation have been made: F. M. Trefusis, Exeter College, and M. W. C. Oldfield, University College, in human anatomy; Joyce Wright, Somerville College and J. G. Reid, University College, in pathology; A. L. Jacops, Jesus College, and A. W. D. Leishman, University College, in physiology. Mr. Robert Pakenham-Walsh, of University College, has been awarded the Welsh prize for excellence in anatomical drawing.

Dr. Harlow Shapley of Harvard College Observatory, Cambridge, Mass., has been appointed to deliver the Halley Lecture in 1928.

Two useful educational bibliographies have reached us from the United States Bureau of Education: a classified list of publications of the Bureau of special interest to secondary school teachers, and a record (*Bulletin*, No. 2, 1927) of current educational publications. The latter is a fifty-eight-page pamphlet comprising some six hundred titles classified and annotated.

THE New Education Fellowship is holding its fourth international conference at Locarno on Aug. 3–15, the general theme being "The True Meaning of Freedom in Education." In the list of speakers appear the names of the following, among others: Prof. Pierre Bovet, Director of the International Bureau of Education, Geneva; Mrs. Beatrice Ensor and Dr. Elisabeth Rotten, Directors of the New Education Fellowship; Dr. Alfred Adler, founder of the School of Individual Psychology, Vienna; Prof. Carson Ryan, of Swarthmore College, U.S.A., President of the National Vocational Guidance Association; Dr. Carleton Washburne, Superintendent of Schools, Winnetka, U.S.A.; Sir Jagadis C. Bose; Prof. O. Decroly of Brussels, originator of the Decroly method; Dr. Adolphe Ferrière, founder of the International Bureau of New Schools; M. P. Otlet; and Mme. Guéritte, of La Nouvelle Education. Bedales, Frensham Heights, and other pioneer schools are to be represented. There will be an exhibition of children's work and auto-didactic material. The headquarters of the Fellowship are at 11 Tavistock Square, London, W.C.1.

Calendar of Discovery and Invention.

July 31, 1846.—In 1840, Lord Armstrong, then a lawyer thirty years of age, in a letter to the *Mechanics' Magazine*, directed attention to the advantage of water under pressure as a mechanical agent and a reservoir of power. Six years later he erected a crane on the quay at Newcastle which was worked by water power, and on July 31, 1846, took out a patent for an "apparatus for lifting, lowering and hauling." This was the beginning of the present extended use of hydraulic pressure for cranes, capstans, lifts, gun machinery, and machine tools. To develop his machinery, Armstrong in 1847 joined the small engineering firm of Donkin, Cruddas, Potter, and Lambert, of Elswick, and from this sprang the world-famous engineering works on the Tyne.

August 1, 1774.—Oxygen was discovered independently by Priestley and by Scheele, Priestley's famous experiment with the red oxide of mercury being made on Aug. 1, 1774. The new gas, thought by Priestley to be common air deprived of its 'phlogiston,' was called by him 'dephlogisticated air,' and it was Lavoisier who named it oxygen.

August 3, 1677.—One of the earliest scientific academies was that founded in Germany in 1652 and on Aug. 3, 1677, given the title "Sacri Romani Imperii Academia Naturae Curiosorum" by the Emperor Leopold I. The inauguration of this society was stimulated by the writings of Bacon, and it is known to-day as the "Leopoldinish-Carlonische Deutsche Akademie der Naturforscher" of Halle.

August 4, 1877.—Many inventors have contributed to the improvement of internal combustion engines, but the greatest single improvement was that made just fifty years ago by the German engineer, Nicolas Otto (1832–1891), who on Aug. 4, 1877, took out the German patent for the well-known four-stroke cycle of operations. Lenoir and Hugon had produced the first practical gas engines, and these had been superseded by the engine invented by Otto and Langen in 1866. All these, however, were far inferior to the new type of Otto, who introduced the plan of compressing the explosive mixture in the working cylinder as proposed by Barnett in 1838.

August 4, 1894.—The exploration of the upper atmosphere by means of self-registering instruments lifted by kites was initiated by Abbott Lawrence Rotch (1861–1912), whose first experiments were made on Aug. 4, 1894. Rotch was the founder of the meteorological observatory at Blue Hill, Hyde Park, Mass., 635 feet above sea-level.

August 5, 1816.—Among the pioneers of the electric telegraph was Sir Francis Ronalds who, before the invention of the voltaic battery and the discoveries of Oersted, in 1816 laid down some miles of wire in his garden at 26 Upper Mall, Hammersmith, and transmitted charges by means of friction machines. His offer of a demonstration led to the Admiralty official reply, dated August 5, 1816, "That telegraphs of any kind are now totally unnecessary, and that no other than the one in use [the semaphore] will be adopted."

August 6, 1812.—Regular steamboat traffic in Europe began with Henry Bell's *Comet*, launched on July 24, 1812, which began her trips on Aug. 6. *The Glasgow Herald* of Aug. 10 contained the following paragraph: "We understand that a beautiful and commodious boat has been just finished, constructed to go by wind, power and steam, for carrying passengers on the Clyde between Glasgow, Port Glasgow, Greenock, and Gourock. On Thursday it arrived at the Broomielaw in three hours and a half from Port Glasgow." E. C. S.

Societies and Academies.

LONDON.

Optical Society, June 9.—T. H. **Harrison**: The use of photo-electric cells for the photometry of electric lamps. A description is given of apparatus and experiments designed for giving the highest accuracy and precision in the photometry, using photo-electric cells, of electric lamps. Although the methods adopted are not novel, yet every care has been taken to obtain the highest sensitivity in the photo-electric current measuring apparatus and to maintain the lamps at a steady, accurately known voltage. It is claimed, therefore, that the results are useful in showing the maximum capabilities of photo-electric cells when used in the usual manner with a sensitive electrometer or electroscope. Sources of error and their elimination and the computation of the accuracy of the results are discussed.—R. **Kingslake**: An experimental study of the best minimum wave-length for visual achromatism. A special telescope is described, in which the chromatic aberration can be varied continuously without introducing any other undesirable aberrations. By the aid of this apparatus, many determinations have been made as to the best type of achromatism for visual observations, in daylight, in artificial light, and on astronomical objects. Several observers were employed to make settings, and their opinions as to the most desirable type of achromatism are tabulated and compared. In general it is found that a moderate amount of undercorrection is required to give a truly colour-free image, that less undercorrection is needed if the best definition is to be obtained, and that a slight overcorrection is desirable for astronomical work.—S. K. **Datta**: On Brewster's bands (Part ii.). The nature of the patterns obtained by the superposition of two systems of Haidinger's rings when the actual law of spacing of the rings is considered is discussed.

Mineralogical Society, June 14.—A. F. **Hallimond**: On the atomic volume relations in certain isomorphous series. For isomorphous salts of the eutropic elements potassium, rubidium, cæsium, the differences cæsium-potassium and rubidium-potassium stand in constant ratio, and the same ratio holds good for the free metals, though these are considerably larger than in the combined state; the constancy does not extend to the salts of ammonium or thallium. A modified additive relation is indicated, the volumes of the metals when free and when combined being in the same ratio as the differences for the free metals and for the respective isomorphous series. This would appear to be a distinctive character of each 'eutropic' group of elements.—P. K. **Ghosh**: Petrology of the Bodmin Moor granite (eastern part), Cornwall. Three types of granite are mapped and described in detail: (1) an earlier coarse-grained 'normal granite,' followed by (2) a coarse-grained granite of Godaver type, and (3) a fine-grained granite. Various minor intrusions connected with these are described, and also their altered facies. Several types of hornfelsed inclusions of sedimentary rocks are distinguished.—P. G. H. **Boswell**: On the distribution of purple zircon in British sedimentary rocks. The properties and behaviour under radioactive treatment of purple zircon from sedimentary rocks are described. The mineral occurs at practically every horizon in British sedimentary rocks. In the Carboniferous, Permian, Triassic, and Aptian rocks it is especially abundant, and is there associated with numerous other minerals apparently freshly derived from crystalline metamorphic rocks.—J. **Drugman**: On β-quartz twins from Cornwall. β-quartz seems to be sufficiently differentiated from α- or low-temperature quartz for the two to be treated quite apart from each other. This is specially the case with the twin-laws one observes in these. In β-quartz, twinning with inclined axes is a very common occurrence indeed, and examples are very abundant in the Cornish localities at Belowda Beacon, a china-clay pit near Belowda Beacon and Wheal Coates. Besides twinning on $(10\bar{1}1)$, Estérel twinning, and twinning on $(11\bar{2}2)$, three new laws are stated, namely, twinning on $(30\bar{3}2)$, confirmed by a good Estérel specimen; twinning on $(20\bar{2}1)$ (and perhaps on the Zinnwald law) and lastly twinning on $(21\bar{3}2)$, also confirmed by an Estérel specimen. This latter is, however, probably of extremely rare occurrence.—E. V. **Holt** and H. F. **Harwood**: The separation of manganese in rock analysis. The whole of the manganese can be completely precipitated with the alumina and ferric oxide. The solution after removal of silica is diluted to 400 c.c., heated to boiling after the addition of ammonium chloride, and ammonia added to alkalinity. Bromine water is then run in very slowly from a tap funnel, small additional quantities of ammonia being simultaneously added to keep the solution alkaline. When the addition of the bromine is complete the liquid is boiled for one minute and then filtered. The precipitate is redissolved and the precipitation repeated; in the combined filtrates lime and magnesia are determined by the usual methods. The results are perfectly satisfactory up to a limit of 50 mgm. MnO; when more than that quantity is present, some lime and magnesia are liable to be carried down with the alumina precipitate, but such a case will practically never occur in rock analysis.—L. J. **Spencer**: Corundum twins from Transvaal. Large twinned crystals of corundum, up to 6 inches across but only about an eighth of an inch thick, are abundant in plumasite rock near Bandolier Kop, northern Transvaal. The twin-plane is a face of the primary rhombohedron and the twinned crystals have a form resembling arrow-heads.

Royal Meteorological Society, June 15.—J. Edmund **Clark**, I. D. **Margary**, and R. **Marshall**: Report on the phenological observations in the British Isles, December 1925 to November 1926. 373 sets of records were received, but observers would be welcomed in the western halves of Ireland and Scotland, and all Scotland north of Inverness. The five weeks' cold spell preceding Christmas 1925 retarded the first indications of the new season's growth, but this was quickly neutralised by warmth equally abnormal, culminating in the closing week of winter and continued on to Easter. In consequence flower, bird, and insect records were very early up to mid-April, notable being those of the arrival of cuckoo and swallow and flowering of hawthorn. Then everything was retarded by a long spell of cold, worst about mid-May, injuring the fruit crop, particularly apples. June was cool and very dry and in many parts July brought a deluge. Field crops were helped by a dry summer and fairly warm August, warm September and early October. Grain expectations failed of full realisation upon threshing. Destructive mid-October frosts damaged late potatoes and practically wiped out autumn colouring. Many records were obtained of the return after this of swallows and housemartins, often lingering all through November and in some cases into December.—G. C. **Simpson**: Past climates. The paper discusses from the meteorological point of view the possible changes in climate which can be brought about by changes in the physical condition of the earth's surface—chiefly changes in the extent and

distribution of the land masses and changes in their height—unaccompanied by any variation in solar radiation. The zonal distribution of temperature has not materially changed; there must always have been a cold polar zone, a warm tropical zone, and an intermediate temperate zone, all very similar to those which exist to-day. Further, a detailed examination of the existing variations in mean annual temperature along various circles of latitude leads to the conclusion that no rearrangement of land and water could have produced larger variations of mean annual temperature than are to be found in the northern hemisphere to-day. The ice sheet which covered north-west Europe during the last great ice-age could not have been caused by the elevation of Scandinavia. The present conditions in tropical regions, where in the coldest parts the snow-line is to-day more than 5000 metres above sea-level, lead to the conclusion that ice could never reach sea-level within the tropics.

DUBLIN.

Royal Irish Academy, June 27.—H. **Ryan** and V. **Coyle**: The hydrolysis of *n*-butyl nitrate. *n*-Butyl nitrate, formed by the action of nitric and sulphuric acids on *n*-butyl alcohol, reacted very slowly with cold aqueous or alcoholic potash. With a warm solution of potash the ester was, unlike those of the polyhydric alcohols, readily converted into butyl alcohol and potassium nitrate. In addition to these bodies, potassium nitrite and a resin were formed. Alcoholic ammonia had little action on the nitrate, but in the presence of sulphuretted hydrogen, butyl alcohol was formed very readily.—H. **Ryan**, J. **Keane**, and J. C. **McGahon**: On 3-nitrodiphenylene oxide. Two mononitro derivatives of diphenylene oxide are known. One of these melts at 182° C. and the other at 110° C., and each in turn has been assumed to be 3-nitrodiphenylene oxide. It is now shown that the latter body is a new mononitro-diphenylene oxide melting at 141° C., which is obtained by diazotisation of 2-amino-4-nitrodiphenyl ether, followed by elimination of nitrogen with formation of the diphenylene oxide grouping.—Joseph **Doyle** and Phyllis **Clinch**: Seasonal changes in conifer leaves, with special reference to enzymes and starch formation. The absence of starch from evergreen leaves in winter is largely due to an internal change which necessitates, irrespective of temperature, a great increase in sugar concentration before starch synthesis begins. This has to be related to corresponding changes in the carbohydrate enzymes. Although invertase is always present, maltase, dextrinase, and amylase may be absent or much less active in winter. Starch may develop in the absence of maltase and dextrinase; and, in some cases, independently of assimilation, light may be necessary for its formation in winter. Osmic acid staining substances are very plentiful, but they are not fat, which is sparingly present if at all. Lipase is not detectable at any season.

PARIS.

Academy of Sciences, June 20.—G. **André** and E. **Demoussy**: The distribution of potassium and sodium in plants. From the experimental facts given, it follows that the distribution of potassium and sodium, considering only the soluble forms, is dependent on diffusion. During the growth of the plant the most mobile element, the potassium, travels farthest from the mixed solution. After the period of growth the ratio potassium/sodium tends to fall.—P. **Viala** and P. **Marsais**: A new disease of grapes (scleriasis), due to *Sordaria uvicola*. Details of mode of growth and effects of this fungus are given, which at present is confined to Bessarabia.—Pierre **Bazy**: Remarks on the note by M. Raymond Hamet. A protest against the conclusion that in cases of syncope under chloroform or other anæsthetics the injection of adrenaline may be harmful. The author contends that the value of the adrenaline injection in such cases is well proved.—**Riquier**: The general integration of the partial differential equation $s=f(x, y, z, p, q)$.—Charles **Camichel**: The vortices provoked by an obstacle immersed in a flowing liquid. A résumé of experiments made by the author in collaboration with Dupin, Escande, and Teissié Solier.—Amé **Pictet** and H. **Vogel**: The synthesis of maltose.—René **Maire** and Paul de **Peyerimhoff**: The discovery of *Pinus nigra* in the north of Africa. This pine has not hitherto been met with in Africa. The age and position of the trees exclude the possibility of introduction from Europe during French occupation.—Charles **Fabry** was elected a member of the section of general physics in succession to the late Daniel Berthelot, and Alexis **Carrel** a *correspondant* for the section of medicine and surgery.—Otakar **Borůvka**: The projective geometry of the analytical correspondences between two planes.—Gaston **Julia**: Remarks on the singular right lines of congruences.—J. **Hjelmslev**: The invariants of integral series.—André **Roussel**: An intermediate method of the calculus of variations.—G. **Pólya**: Integral functions with lacunar series.—Gr. **Fichtenholz**: Suites of analytical functions.—**Biernacki**: The displacement of the zeros of integral functions by their derivation.—K. **Veliovitch**: The periodic orbits of the problem of three bodies with impacts of two bodies.—P. **Fatou**: The movement of the nodes of certain orbits.—Emile **Belot**: The origin and values of the eccentricities of the orbits according to the dualist cosmogony.—L. **Rosenfeld**: The magnetic electron and wave mechanics.—V. **Posejpal**: The yield of fluorescence of the *K* level for the *Kα* lines.—R. **Descamps**: The natural rotatory dispersion, in the range of the ultra-violet spectrum, of four aqueous solutions of tartaric acid.—**Beauvais** and **Mesny**: An arrangement of the Faraday cage for radio-telegraphy.—Mlle. St. **Maracineanu**: Researches on the radioactivity of matter after long exposure to solar radiation. In a previous communication it has been shown that a leaden roof, which had been exposed for a long period to solar radiation, showed distinct radioactivity. That this lead was not originally radioactive has now been proved by cutting out a piece of the lead (2 mm. thick) and examining it in the laboratory. Only the exposed face was found to be active, the radioactivity on the under side being nil. The possibility that the radioactivity found was due to radioactive deposits from the atmosphere was disproved. Zinc and copper from the same roof also showed radioactivity, but less than the lead.—H. **Deslandres**: Remarks on the preceding communication. The importance of these results is emphasised and the necessity for additional research indicated. The facts at present known would appear to be best explained as being due to a special action of the sunlight.—H. **Jedrzejowski**: The charge of the α-rays emitted per second by 1 gram of radium. The method used was based on that of Rutherford and Geiger; with some additional refinements. The charge emitted by 1 gm. of radium was found to be 33·4 electrostatic units per second, corresponding to the number of α-particles $N = 3{\cdot}50 \times 10^{10}$. This is in good agreement with recent results of H. Geiger and A. Werner, of J. Thibaud and of L. Meitner, but is appreciably lower than the $3{\cdot}72 \times 10^{10}$ found by V. F. Hess and R. W. Lawson.—A. **Andant** and E. **Rousseau**: The photolysis of hydrocyanic acid by the total radiations and by the filtered radiations of

the mercury arc. The data given show that photolysis by ultra-violet light is hindered by the presence of radiations of longer wave-length.—Eugène Cornec and Joseph Dickely: Studies on sodium perchlorate.—Victor Lombard: The permeability of iron and of platinum to hydrogen. The permeability of iron to hydrogen at a given temperature is proportional to the square root of the pressure. At constant pressure and varying temperature, the permeability of iron and platinum to hydrogen, like that of nickel, is of the form $d = a^t$ (a, constant; t, temperature).—Amand Valeur and Paul Gailliot: The passage from trimethylarsine to cacodylic acid. Trimethylarsine is converted into the dichloride by the direct action of chlorine; at 180° C. this gives methyl chloride and cacodyl chloride, and the latter is quantitatively oxidised to cacodylic acid by means of hydrogen peroxide.—Charles Prévost: An unexpected reaction of the di-isocrotyl dibromides.—Marcel Bouis: The addition of hydrobromic acid to the allene hydrocarbons.—Paul Gaubert: Helicoidal building up in crystals.—Louis Barrabé: The Jurassic and Cretaceous sedimentary series of the western coast of Madagascar, between Manambolo and Manambao.—F. Blondel: The recent volcanic action in the south-east of Indo-China. The magnitude of the volcanic area is remarkable, but owing to the deep changes in the basalts and the absence of sedimentary strata, the exact date of the eruptions cannot be determined with accuracy.—J. MacLaughlin: Measurements on the large ions at Paris.—Ch. Maurain: Magnetic measurements in Alsace and Lorraine.—Henri Coupin: The carbon nutrition of *Penicillium glaucum* by means of various organic compounds of the fatty series. Out of 47 organic substances added to an inorganic culture medium, Penicillium can use carbon from 22 of them, including ethyl alcohol, glycerol (but not glycol), sugars, malic and succinic acids.—Denis Bach: The nitrogen nutrition of the Mucorineæ. The assimilation of the nitric ion.—Robert Lami: The influence of a peptone on the germination of some Vanda.—Jean Bathellier: The fungus cultures made by the Indo-Chinese ants.—Ch. Brioux and J. Pien: The lime requirements of acid soils. The slow reappearance of acidity after saturation with lime.—Jacques Pellegrin: The barbel of Morocco.—H. Joyet-Lavergne: The relations between glutathione and the chondriome. Some results obtained by the use of sodium nitroprusside as a histological reagent for glutathione.—Philippe Fabre: The shunt shock on the gastrocnemius of the frog.—Joseph Thomas: Injections of cancerous autolysates in the treatment of cancer.—Marcel Duval and P. Portier: The total carbon dioxide content of the blood of freshwater invertebrates and marine invertebrates. The blood of freshwater invertebrates is richer in carbon dioxide than that of marine invertebrates. No reason can be assigned for this difference.—R. Fosse and A. Hieulle: The identification of allantoic acid in the leaves of *Acer pseudoplatanus*.—H. Cardot, J. Régnier, D. Santenoise and P. Varé: The variations of the cortical excitability, in relation with the pneumogastric excitability, the thyroid apparatus and the muscular activity.—H. Simonnet and G. Tanret: The hypoglycæmic properties of galegine sulphate.—J. Cantacuzène and O. Bonciu: The agglutinability acquired on contact of scarlatina filtrates by bacteria heated to 60° C.—X. Chahovitch and Mlle. Vichnjitch: The energy metabolism in the course of experimental tuberculosis.

ROME.

Royal National Academy of the Lincei, April 24.—L. Tonelli: A property of integrable functions.—G. Armellini: Selective absorption of the terrestrial atmosphere and the effective and apparent stellar temperature. The effect produced on the spectrum of a star by the selective absorption of the earth's atmosphere is to render the distribution of energy in the stellar spectrum such as would be obtained from the radiation of a black body at a temperature different from, and lower than, the effective temperature of the star. The difference between the two temperatures is proportional to the selective atmospheric constant and to the square of the effective temperature.—A. Lo Surdo: The electric current filtered through a saturated thermionic valve. If a saturated thermionic valve is inserted in a circuit with the object of filtering the current due to a pulsating electromotive force, the pulsations of the current are greatly attenuated but cannot be entirely eliminated.—L. Rolla and G. Piccardi: Electro-affinity potential of molybdic anhydride. Measurements made by the flame method give the value 2·73 volts for the electronic affinity potential of molybdic anhydride rendered free from bases by sublimation. This result is calculated on the assumption that, at the flame temperature employed, namely, about 1970° absolute, the anhydride undergoes no appreciable dissociation.—S. Franchi: Geology of the northern Appennines.—R. Calapso: A transformation of the rectilinear congruences W.—S. Cherubino: The surface integrals of quadratic differential forms.—S. Bernstein: New demonstration of an inequality relating to trigonometrical polynomials.—O. Onicescu: Geodetic displacement, stability, and Whittaker's problem.—A. Rosenblatt: Kutta-Joukowski's theorem.—E. Fermi and F. Rasetti: Measurement of the ratio h/k by means of the anomalous dispersion of thallium.—U. Sborgi: Anodic behaviour of metals in non-aqueous solutions. Comparison of the results obtained on electrolysing sodium and ammonium chlorides, and ammonium nitrate in aqueous and in ethyl alcoholic solutions indicates that, to a large extent, the anodic behaviour of metals is similar in aqueous and non-aqueous solutions.—G. Malquori: The systems $AlCl_3$—HCl—H_2O, KCl—HCl—H_2O, and KNO_3—HNO_3—H_2O at 25° (iii.). The solubilities of aluminium and potassium chlorides in water are diminished by the presence of hydrochloric acid. On the other hand, potassium nitrate is increased in solubility by addition of nitric acid to the aqueous solution; aluminium nitrate, however, follows the general rule.—C. Fontana: Identity of the crystalline structures of Fe_3S_4 and FeS. The results of X-ray analysis show that the interaction of magnetite and hydrogen sulphide under the ordinary pressure at 1000° is expressed by the equation:

$$Fe_2O_3 . FeO + 4H_2S \longrightarrow 3FeS + S + 4H_2O.$$

The sulphur does not occupy a fixed, characteristic position in the crystal lattice, and the existence in the product of the reaction of the compound Fe_3S_4 as a chemical individual cannot be regarded as proved.—A. Ferrari: Crystalline structure of iodine. Investigation by Laue's method, in conjunction with the rotating crystal method, shows that iodine exhibits a rhombic lattice, the elementary cell of which consists of an orthogonal parallelepiped containing eight atoms and having the dimensions $a = 4·760$ Å.U.; $b = 7·164$ Å.U.; and $c = 9·783$ Å.U.—D. Bigiavi: Action of peracetic acid on the acetyl derivatives of aromatic amines. The action of peracetic acid on aromatic amines yields the corresponding nitro-compounds, together with the azoxy-compounds, but similar treatment of the acetyl derivatives of the amines gives the nitro-compounds alone.—G. Natta: Crystalline structure of the chlorides of tervalent metals (i.). Chromic chloride. This salt crystallises

in the rhombohedric system and probably in the holohedral class, its elementary cell containing one molecule of $CrCl_3$ and having the side $a = 4{\cdot}42$ A.U. and the axial ratio $c : a = 1{\cdot}29\text{-}1{\cdot}30$. The calculated density is 2·71.—C. Perrier: Two recent notes by Philibert. The apparent biaxiality which may occur with Iceland spar when observed with the help of Federow's plate does not detract from the value of this plate when the segments are properly mounted. —D. Cattaneo: Ultramicroscopy of the crystalline lens (i.). The ultramicroscopic character of the normal crystalline lens. Ultramicroscopic investigation confirms Bottazzi's view that the protoplasm of the crystalline lens consists essentially of optically homogeneous material, but shows also that the crystalline fibres may contain a phase differing optically from such homogeneous material.

Official Publications Received.

BRITISH.

Aeronautical Research Committee: Reports and Memoranda. No. 1076: Comparison of Atalanta and Model Sea Worthiness and Fore and Aft Angle. By the Staffs of the Marine Aircraft Experimental Establishment, Felixstowe, and the William Froude National Tank, National Physical Laboratory. (S. 33.) Pp. 9+6 plates. (London: H.M. Stationery Office.) 1s. net.

Royal College of Surgeons of England. Annual Report on the Museum, by the Conservator. Pp. 28. (London.)

Annual Report of the Imperial Institute of Veterinary Research, Muktesar, for the Year ending 31st March 1926. Pp. 18. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10d.

Report of the Director-General of Public Health, New South Wales, for the Year 1925. Pp. vi+207. (Sydney, N.S.W.: Alfred James Kent.) 8s. 9d.

Scientific and Industrial Research Council of Alberta. Report No. 18: The Bituminous Sands of Alberta. Part 1: Occurrence, Studied with respect to Commercial Development. By K. A. Clark and S. M. Blair. Pp. 74+7 plates. (Edmonton, Alba.: W. D. McLean.)

Trinidad and Tobago. Administration Report of the Conservator of Forests for the Year 1926. Pp. 19. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year 1926, with Report of the Director of Fuel Research. Pp. vi+62. (London: H.M. Stationery Office.) 1s. 3d. net.

Air Ministry: Meteorological Office. International Meteorological Organization: Commissions for Terrestrial Magnetism and Atmospheric Electricity and for the Réseau Mondial. Reports of the Meetings in Zürich, September 1926. (M.O. 296.) Published by the Authority of the Meteorological Committee. Pp. 34. 9d. net. International Meteorological Organization: Commission for Synoptic Weather Information (formerly Commission for Weather Telegraphy). Report of the Sixth Meeting, Zürich, September 9-16, 1926. (M.O. 293.) Published by the Authority of the Meteorological Committee. Pp. 105. 2s. net. (London: H.M. Stationery Office.)

Mines Department. Publications of the Safety in Mines Research Board. Vol. 1, 1923, 1924 and 1925. Reports and Papers relating to Research into Coal Dust, Firedamp and other Sources of Danger in Coal Mines. Subject Index. Pp. xiii. (London: H.M. Stationery Office.) 2d. net.

FOREIGN.

Report of the National Research Council for the Year July 1, 1925–June 30, 1926. Pp. iv+106. (Washington, D.C.: Government Printing Office.)

Cornell University Agricultural Experiment Station. Bulletin 458: The Climate of Long Island; its Relation to Forests, Crops and Man. By Norman Taylor. Pp. 20. Memoir 100: A Study of Pogoniris Varieties. By Austin W. W. Sand. Pp. 159+3 plates. Memoir 105: The Manufacture of Cheddar Cheese from Milk pasteurized by the Holder Method. By Walter V. Price. Pp. 36. (Ithaca, N.Y.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 4: Bibliography of certain Aspects of Rural Education. (From January 1, 1920, to September 1, 1926.) Pp. viii+56. (Washington, D.C.: Government Printing Office). 5 cents.

Bulletin of the National Research Council. No. 58: Handbook of Scientific and Technical Societies and Institutions of the United States and Canada. American Section compiled by Clarence J. West and Callie Hull for the Research Information Service, National Research Council, United States; Canadian Section compiled by National Research Council, Canada. Pp. 304. (Washington, D.C.: National Academy of Sciences.) 3 dollars.

Reprint and Circular Series of the National Research Council. No. 75: Doctorates conferred in the Sciences by American Universities, 1925–1926. Compiled by Callie Hull and Clarence J. West. Pp. 34. 50 cents. No. 76: Directory of Research in Child Development. Compiled for National Research Council Committee on Child Development by Leslie Ray Marston. Pp. 36. 50 cents. No. 77: Mathematics and the Biological Sciences. By Horatio B. Williams. Pp. 21. 25 cents. (Washington, D.C.: National Academy of Sciences.)

The Rockefeller Foundation. A Review for 1926. By George E. Vincent. Pp. 54. (New York City.)

Bulletin géodésique. Organe de la Section de Géodésie de l'Union Géodésique et Géophysique Internationale. Année 1925, No. 7, juillet, août, septembre 1925. Pp. 351. Travaux de la Section de Géodésie de l'Union Géodésique et Géophysique Internationale. Tome 2: Rapports généraux établis à l'occasion de la Première Assemblée générale, Rome, 2-10 mai 1922. Pp. vii+99+10+77+26+85+7. (Toulouse: Édouard Privat; Paris: J. Hermann.)

Year Book, The Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1926. Pp. 110+7 plates. (Philadelphia, Pa.)

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 16, Arts. 5 and 6: An Experimental Investigation of the Relations of the Codling Moth to Weather and Climate, by Victor E. Shelford; A Study of the Catalase Content of Codling Moth Larvae, by C. S. Spooner. Pp. 367-446. (Urbana, Ill.)

Kornstørrelseforsøk: Forsøk, undersøkelser og iakttagelser til belysning av spørsmålet—stor- eller småkornet såvare i plateproduksjonen. Av Prof. Emil Korsmo. (Særtrykk av Meldinger fra Norges Landbrukshøiskole, 1927.) Pp. 76. (Oslo: Johansen and Nielsens Boktrykkeri.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 82: Archeological Observations North of the Rio Colorado. By Neil M. Judd. Pp. ix+171+61 plates. (Washington, D.C.: Government Printing Office). 1 dollar.

CATALOGUE.

Radiography for the Dentist. (Bulletin No. 82.) Second edition. Pp. 37. (London: Watson and Sons (Electro-Medical) Ltd.)

Diary of Societies.

CONGRESSES.

EMPIRE MINING AND METALLURGICAL CONGRESS.

Montreal Meetings, August 22 and 23.—Sir Thomas Holland: Proposed Review of the Mineral Resources of the Empire.—G. M. Carrie and C. S. Pascoe: Magnesia Refractories for Steel Furnaces.—A. Stansfield: Smelting Titaniferous Iron Ores.—W. A. Toohey: Portland Cement in Canada.—Mining and Metallurgical Practice in Australia.—Health Safety Problems.

Toronto Meetings, August 25 and 26.—C. Johnson: Winning and Refining of Precious Metals from Sudbury Ores.—R. C. Stanley: Nickel, Past and Present.—A. A. Cole: The Silver Mining Industry of Canada.—J. G. Morrow: The Cascade Method of Pouring Steel.—A. Mavrogordato and H. Pirow: Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3.—G. E. Cole: The Development of Gold Mining in Canada.—W. A. Quince: Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine.—C. R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger: A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14.—C. P. Browning: Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J. Lee: The Coal Industry in Western Canada.—J. Ness: Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone: A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linsi Mine of the Kailan Mining Administration, North China.—A. E. Cameron: Impact Resistance of Steel at Low Temperatures.

Quebec Meetings, September 5 and 26.—J. G. Ross: Asbestos Mining and Milling.—A. W. Nash: Possible Auxiliary Sources of Liquid Fuel.—A. Job: The Sinking and Equipment of the Ventilation Shaft of the Government Gold Mining Areas.—G. W. Sharp: The Tipping and Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 and 10.—F. W. Gray: Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadfield: The Metal Manganese and its Properties: also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

SEPTEMBER 1–4.

SCHWEIZERISCHE NATURFORSCHENDE GESELLSCHAFT (at Basel) (in 14 Sections).—Presidential Address by Dr. F. Sarasin.—Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

SEPTEMBER 4–9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

SEPTEMBER 11–17.

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

SEPTEMBER 11–18.

INTERNATIONAL CONGRESS OF GENETICS (at Berlin).

SEPTEMBER 18–OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome).