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Unemployment and Hope.

EVEN the most strictly scientific mind may, at the approach of spring, be allowed to wander somewhat out of the old and beaten track—indeed the scientific mind should be constantly on the search for new tracks—to indulge in flights of imagination and of hope, especially of hope. It is the season of new hopes, new resolves, new thoughts, and though the hardened cynic may smile at their apparent futility, yet, however often we fall and fail, it is best to go on trying and keep the shining portals of hope, far distant though they be, still in view. *Dum spiro, spero.* So, in our title we have included hope, even in connexion with unemployment, and thus very flagrantly broken that excellent rule of the strictest school of economics which would rigidly exclude from consideration everything outside the indicative mood, and certainly everything appertaining to the optative mood (*vide* Prof. Florence in his recent work on statistical method in economics).

In the following few notes and crude suggestions the point of view is taken that we should make the best of our present industrial civilisation, that that best is better than is often imagined ; that perfect safety in the cosmic adventure, perfect ease, pleasure, and a generally 'soft time' for everybody, are unattainable ; that danger and difficulty are always present and will increase in proportion as we advance ; and that this progressive advance in the face of increasing danger and difficulty is the thing best calculated to develop a nation's highest qualities. Nothing revolutionary is proposed, for a fairly thorough comparative study of economic systems past and present, including many so-called Utopias, has convinced us that nothing revolutionary can be proposed on any rational basis.

Our present industrial society has many elements of strength and stability, and even of nobility, to which attention has been only slightly or not at all directed, and many elements of weakness on which attention has been unduly concentrated. There is much that is sound and healthy, as is evidenced by the amazing fact that, despite the overwhelming ills with which it is supposed to be afflicted, society has continued as a going concern to this day in wonderful vigour, whereby millions are enabled to live a fairly healthy, active, and more or less happy life, and wherein hundreds of thousands find scope and opportunity—of which, to their unbounded credit, they fully avail themselves—for exercise of the highest virtues of integrity, skill, and courage. These elements and

scope for their exercise can be increased almost indefinitely, and much that is evil will thus automatically be reduced or held in check; but not, perhaps, altogether exterminated, for the mysterious shadow of evil remains a sinister spectre in the background of all man's endeavour, leading him constantly into danger, and spurring him ever to greater efforts. It is well that it is so.

The aims of industry are, or should be, as indicated in a previous article, chiefly two: (1) to furnish a field for exercise of faculty and growth of character; and (2) to produce commodities to satisfy man's varied wants, mostly of a material kind, though of course there are large exceptions outside the material category, and the term 'material' is here used in no derogatory sense. Attention has hitherto been directed mainly to (2) and the primary aim of industry has been ignored. Such one-sided view of industry coupled with a too narrow use of the much abused word 'evolution'—as we shall see later—has led to over-concentration on quantity and mass production and a ridiculous neglect of the human element; and there can be no doubt that had a little thought been given to the first aim, then the second would have been much more completely and satisfactorily attained; also unemployment would not have been heard of, and, as pointed out, too, in the article referred to, the right use of leisure would have been treated rationally as a dominant factor.

Revolution being excluded, one has naturally turned to evolution as correctly expressing society's progress, assuming that progress in the right direction is being made; Ely's "Studies in the Evolution of Industrial Society" being a noteworthy contribution to the evolutionary view. But the use of the term evolution should not lead us to suppose that modern industry is evolving into some perfect and complete type or consummation. Existence would be very dull and dreadfully boring when such a state had been reached, with nothing left to hope and strive for. Then again, the best form or type of industry may not be and surely is not necessarily one particular fixed static type or form only, but may consist of many different and constantly changing forms, distinguished above all things by adaptability and elasticity—a living organism.

The prevailing idea, with exceptions here and there, appears to be that industry is evolving and must evolve towards one fixed type, for example, that of large-scale production, with division of labour and specialism and consequent monotony of work pushed to still more disastrous extremes. But it is doubtful if this supposed ideal or consummation would work very long, or prove to be the best even from the merely material point of view of quantity production, and it would of course altogether ignore the spiritual aims of industry, namely, scope for development of faculty, character, and sound citizenship. This latter is a vital consideration, for the political strength of a nation is dependent on a spiritual or ethical view of industry.

What is to be more specifically understood as elasticity in the industrial structure is the provision of opportunity for other forms than that of large-scale production only, to develop and see what they can make of themselves. Beside large-scale production, or, more strictly, large-scale capitalistic production, there is co-operative production, which of course may be only another variety of large-scale working but may also include much on the small scale. Large scale also may mean a conglomeration of several small and nearly independent units, such as an association of small dairy farmers, small village artisans or handicraft workers, and many such like. Elasticity further means the possibility of reviving, under new and improved forms to meet modern conditions, two at least of the older types of industry which are supposed to have been superseded or rendered obsolete by modern large-scale production; namely, (1) small cottage industries or handicrafts, sometimes known as 'village industries' or 'home work' (in the factory inspector's reports) and sometimes as 'sweated industries'—as many of them are, though they need not, of course, be 'sweated', for this is an evil excrescence not essentially inherent; (2) a combination of manufacturing with agricultural or garden industry, including the possibility of providing the industrial classes with some form of land interest (see NATURE, Mar. 9, 1929, p. 341). If the evolutionary doctrine, as applied by Herbert Spencer and others to the social body, means that these and perhaps other and older forms of industry are useless anachronisms and may not contain something of vital value at the present day, then its application here has been profoundly erroneous and disastrous, stupid and short-sighted. Industry still has its roots firmly and deeply fixed in the past, and foolishly to tear up a great part of those roots as old and useless is the surest way to weaken the industrial tree. Perchance the source of the unemployment curse is to be found here.

The restitution of these two principles of an older industrial order, so essentially and characteristically English, under improved forms made possible by modern scientific achievement, including notably

electrical power distribution, would furnish, in the first place, a new and almost infinite field for human employment of all kinds, absorbing all or most of the present unemployed, giving extra occupation to those on short time ; also scope for much organising talent and business ability now running to waste—a lot of it among the idle or leisured classes —through lack of opportunity. By unemployed we mean chiefly the unemployed in Great Britain only, but it would be vastly better to extend our consideration to cover unemployment throughout the whole world. For, first, this would provide a splendid additional bond for international co-operation and friendship, of which we cannot have too many ; and, secondly, the solution or even partial amelioration of the unemployment problem in other countries would be bound to have advantageous repercussions on unemployment in Britain.

By accepting these two principles as a basis, with or without some kind of financial reform in the direction of a measurable amount of inflation, possibly on the lines suggested by Arthur Kitson, Douglas, and others, an approach can be made to the unemployment problem, as was done a few years ago rather successfully with the Greek refugees. The application of these two principles to unemployment is, of course, only one part of their scope, for they have a far wider range even than this, especially in counteracting one of the greatest evils of modern industry, namely, extreme specialism, monotonous work, and lack of scope for developing skill, with all that that implies.

Amid much controversy on unemployment, its causes and cures, one fact stands out in unmistakable clearness, and may safely be taken as a starting-point. That is, the unemployed must have the wherewithal to live—food, raiment, shelter, and probably a few things above this wretched minimum. Can they be put in a position to supply most of these things for themselves ? At present they lack a market for their labour, and yet they are themselves a huge potential market for labour and the products of labour. Another indubitable fact, standing clear above controversy even though it comes from the realm of economics, is that the instruments of production are land, labour, capital, and organisation or management. There is plenty of land available or reclaimable in Great Britain. Millions of pounds of capital could be provided by capitalising the 'dole' for five or ten years. The requisite organising and managerial ability is doubtless also in existence, but will have to be diligently sought out : much of it would probably be found or developed among the unemployed themselves, who also would supply the greater part of the labour.

The aim would be to establish a vast productive organisation, consisting in the main of village communities and garden cities, containing both large factories—if need be—and also cottage or home industries and handicrafts. A considerable amount of whole-time intensive farming probably on a large scale, together with market gardening and fruit growing, would be provided for ; but a fundamental feature of the scheme would be a land interest for everybody, mostly a part-time interest wherein they could spend much of their leisure, and would include the possibility of owning homesteads containing up to quarter of an acre or more of land, part of which would be orchard. Training in some form of skilled handicraft would also be available to everybody.

These ideas could of course be applied to British industry generally, and not only to the organisation above mentioned, and thus some sort of antidote at least would be provided against two of the most serious evils of modern industrialism—complete alienation from the land and all that this means, on one hand, and entire lack of scope for exercising skill, on the other. A further evil, that of fluctuating employment, could also be met and means afforded for absorbing or 'damping out' a great part of these miserable fluctuations in labour demand ; and something would have been done towards encouraging the right use of leisure, a vital matter in modern society, the implications of which are as yet too little appreciated. Science and research would play a dominating part, and large research institutes, especially in connexion with horticulture and growing under glass, would be established ; also electrical or other forms of power would be utilised to the utmost, and though the term 'handicraft' may well be retained, it is fully intended that all the resources of modern science and engineering should be applied and every encouragement given to the further development of such resources.

It is probable that, under the more bracing atmosphere of varied work and interest and skill thus envisaged, the inventive faculties of mankind would be greatly stimulated, and a much-needed spur be given to originality. It is doubtless difficult enough to generalise in regard to such an elusive thing as a nation's inventive talent or to trace the laws of its rise and fall ; but it does seem to keen observers that, in view of the attention now devoted to education and research, the amount of originality and creative talent shown is a little

disappointing. We refer not only to the mechanical or physical realm—perhaps it is fairly satisfactory here—but also to other departments of intellectual activity. In the social sciences particularly, the lack of originality is deplorable, and outside empiricists are allowed to have their own way without let or hindrance or effective rejoinder.

If there is any such decline in originality and inventiveness, the chief cause is probably extreme specialism. In Adam Smith's time, division of labour may have been rightly included among the sources of invention: to-day, in its present extreme form, it is very likely a potent agent of torrefaction, and the springs of intellectual creativeness are dried up. But never before in the history of the world has there been a greater or more urgent need for originality and freshness of view than now; and freshness of view includes seeing old ideas in a new light, old principles in new applications and environment.

W. G. LINN CASS.

The Structure of St. Paul's Cathedral.

St. Paul's Cathedral. By Arthur F. E. Poley. With introduction by Sir Reginald Blomfield. (Printed for the Author, "Willowbank", Hampton Hill, Middlesex.) £7 7*s*. net.

THE author of this magnificent monograph to the genius of Sir Christopher Wren, as exemplified in the neo-classic masterpiece of St. Paul's Cathedral, has produced with immense skill a work adequate for its subject. Just and yet sensitive feeling, a perfection of refinement in draughtsmanship, and a devoted patience in execution, are distinctive throughout this work. The standard set is high indeed and has reached the peak of accomplishment; it has been held there throughout, with an almost grim determination. If there is a sense of effort in the monograph—a feeling as of a continuous striving—throughout this great record, which is not too apparent in the original work itself—that must be set down to the invariable difference between the soaring accomplishments of genius and those of the more mundane service of the historian; which last must pursue naturally a more pedestrian route, and follow the way of prose. This, of course, will always be apparent unless the supreme artist enlightens us with his appraisement and knowledge, as reflecting on the work of another artist; for he alone could bring to the matter that unimpeachable intuition of the artist and the craftsman, native to the medium in which both work.

The text of Mr. Poley's monograph is also excellent; but its outstanding merit is the painstaking, amazingly patient, and skilful draughtsmanship reproducing with complete accuracy all the details of this supreme work of architecture.

The volume contains matter historical and biographical, with building accounts and practical data, all entirely admirable in their way, but, perhaps wisely, no attempt has been made to examine into and explain the vast statical problem which faced Sir Christopher Wren in the technical resolution of his design.

Wren was a fine mathematician, and it is perhaps fair to assume that coming comparatively late to the practice of architecture, he was not intimately acquainted with the practical science of the nature of materials and their behaviour under loading, or their interaction when erected into a structure in intimate association; all parts of the problem of architecture which call for the closest scrutiny into their maximum resistances under compressive and tensional stress.

As a slight evidence of this supposition, witness Wren's surprising action in building into the eight great piers supporting the immense load of St. Paul's dome (some 50,000 tons approximately), a core of rough-mortared, uncoarsed and unbonded fragments of soft Caen stone, and indurated chalk, many fragments calcined by the fire of the old cathedral, and all taken from the demolished building which preceded his own.

It might well have been thought that Wren would have recognised that such a core would be unequal in bearing capacity to the external skins of his piers, faced with Portland stone. This one factor in the problem of the preservation of St. Paul's must have presented a serious difficulty to the highly expert committee dealing with the repair of the Cathedral, and must indeed remain a matter of anxious concern for all those in charge of the structure in the future.

Again, Wren in his work at Hampton Court suffered odium from his enemies as a result of the fall of the east wall of the Palace consequent upon his building this wing across the recently filled section of the long canal at its west end.

At St. Paul's, Wren apparently built the foundations of his mighty church partly on soil compressed and loaded by the previously built cathedral, and partly upon unloaded and virgin soil, inevitably incurring a risk of relative settlements, as can indeed be found to have occurred in an examination of the structure to-day.

Instances of this apparent lack of the strictly technical or merely practical knowledge of the use

of materials and the incidence of loading in building, can be multiplied; yet so profound and masterly was Wren's grasp of the main statical problems of his work, that these presumed defects in his science of construction—or shall we say this early lack of experience in building practice?—have not apparently imperilled as yet the great work which he did throughout the metropolis. They must, however, cause serious heart-searching on the part of those charged with the important responsibility of preserving all the work of his genius for posterity, unaltered and in their complete integrity.

The authorities of St. Paul's are, we believe, fully alive to their responsibility in this matter, and the wise assiduity with which Canon Alexander discovers and criticises any proposal which may be held likely to disturb the *status quo* or the conditions of solum, etc., surrounding the Cathedral, is evidence of this.

The new architectural technique which has been slowly developed within the last half-century, directed to the examination and understanding of the structural stability of old buildings, and the statical conditions which remain as a result of centuries of depreciation and change in the materials of which they were constructed, will, in the future, we feel sure, be capable of making accurate and yet conservative judgments as to how all the buildings and structures which we consider of vital importance as regards their preservation, can be retained for the future without prejudice to their architectural and historic amenity.

It is a great advance in any event that structural work of preservation should be recognised as involving a different technique from that required by the erection of new structures; and Wren's great cathedral will, in the future, set many and intricate problems for resolution to those who are peculiarly qualified to deal with the changed stability factor in the buildings which survive the onrush of our modern civilisation. Nothing, however, can dim Wren's genius. He treated the renaissance with a freedom, audacity, and original sense of beauty which has never been surpassed, certainly in England. His character contributed to his success; he was a man of deep and simple faith, witness his last words when very old, out of favour with the Court, fallen on evil days and evil tongues, in his little house which he had leased on the Green at Hampton Court. He wrote: "If I glory, it is in the singular mercy of God, who has enabled me to prosecute and finish my great work so conformable to the ancient and true model".

These words show his benign and serene spirit: he had served the Crown and the public for fifty years, with supreme genius and confident activity, and saw the patent which he had received from Charles II. withdrawn. He was succeeded in office by an incompetent, who was unable to maintain the position for even a year, but Wren's work remains an outstanding possession for all time. F. B.

Intensive Drying of Gases and Liquids.

The Effects of Moisture on Chemical and Physical Changes. By Dr. J. W. Smith. (Text-Books on Physical Chemistry.) Pp. xii + 235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 15*s.* net.

THIS is a book which has long been needed. It is a laborious compilation of all the work, until 1928, which has been done on intensive, or as it has been called by Longinescu, ultra drying. A really satisfactory book it is not. All the researches described are put on a level; there is no attempt made to deal critically with the different pieces of work. The consequence is that in cases still under discussion, such as the dissociation of ammonium chloride, some researches which are obviously faulty are given the same weight as those which have been done with the greatest care. Dr. Smith has done one successful piece of work in this field, but he would probably be the first to acknowledge that he has neither the experience nor the knowledge which would enable him to deal faithfully with the work he describes. Perhaps only half a dozen persons in the world could have done this adequately, and probably no one of them would have undertaken the labour of compilation so well done by Dr. Smith.

H. B. Dixon must be regarded as the founder of this branch of chemistry. His discovery, just fifty years ago, of the inertness of a dried mixture of carbon monoxide and oxygen to an electric spark, was the *fons et origo* of all the true cases of intensive drying. He was a pupil of A. G. Vernon Harcourt, perhaps the most careful worker in the history of chemistry; and a good deal of his care and attention to minute detail Dixon has been able to hand on to some of his own students. It is noteworthy that only one substance is capable of acting as a true drying agent. Phosphorus pentoxide owes its unique excellence in this respect to the fact that the product of its action on water is extremely stable. Metaphosphoric acid can be distilled without decomposition at a bright red heat without giving up water. Hence the water which phosphorus pentoxide absorbs, it retains. It has, in addition, the

advantage of being, when pure, inert to a large number of chemical substances.

For those who intend to work in this fascinating field, special training and a special attitude of mind are necessary. It is not work for the slap-dash, get-results-quickly type of chemist. It is hard to possess one's soul in patience when one reads papers, even in journals of good repute, which describe so-called repetition of older work. In one series of papers on the boiling point of liquids, phosphorus pentoxide was introduced into an apparatus containing benzene, and the glass walls were given no chance of drying, since the desiccating agent was submerged in the liquid. In another paper ammonium chloride (guaranteed by the makers as chemically pure !) was used, in spite of the fact that, as the authors admit, the salt turned yellow on heating. In the work of which this is supposed to be a repetition, the ammonium chloride was boiled with nitric acid to destroy amines, sublimed and re-crystallised eight times from the purest distilled water. In the ideal book on the subject, such papers would either have been ignored or their errors pointed out, instead of allowing them to cloud the issue as Dr. Smith has done.

A good preliminary training for this class of work would be the determination of an atomic weight, since any error at once manifests itself by a discrepancy in the result. It must be remembered, however, that the standard of purity of material and care in handling are very much higher than in atomic weight work, since the harmful quantities are imponderable. Dust, often invisible, is probably at the root of many failures. A practice has risen, in both the United States and Germany, of attempting to dry a glass surface by heating in an electric furnace while the apparatus is exhausted. This method " which must produce at least as dry a surface as that attained by Baker " (*sic*) does not get rid of dust as does the standard method of heating the apparatus while a current of purified and dried air is passed through it. It is necessary to burn up the invisible dust particles, for water is not the only effective catalyst. It is also to be noted that in successful experiments the apparatus has been as simple as possible. There should be, theoretically, no limit to the drying by phosphorus pentoxide at the ordinary temperature. The maximum drying in a gas is said to be attained in two years (Bone). For liquids, as might be expected, the drying is much slower. Judging by the boiling point of benzene, its rise in ten years was 38°, in seventeen years it is 56°, and even now the process is probably not complete.

Dr. Smith gives a good account of the various theories which have been advanced to account for the influence of extremely minute traces of water vapour. Prof. H. E. Armstrong, the *doyen* of British chemists, without whose encouragement one at least of the 'dry' chemists would have done little, was the first in the field with the theory of reversed electrolysis. Others, ignoring the theory of probabilities, assume in ordinary actions a linking of water vapour with the reacting gases. Smits, of Amsterdam, one of the most persevering and indefatigable workers, has published a theory based on his well-known theory of allotropy. Sir J. J. Thomson's theory, published in 1894, extended to include the precipitation of water vapour on ions, seems to me to explain all the facts, if one can conceive of a liquid drop of water persisting when surrounded by at least a million other molecules.

With the limitations mentioned, the book may be recommended to students, but they would be wise, if, before beginning experimental work, they read a lecture by Sir Arthur Rücker, published in the *Journal of the Chemical Society* in 1888, and two papers on manipulation in the same journal for 1929.

H. B. BAKER.

Reactions of the Nerve Cell to Injury.

Degeneration and Regeneration of the Nervous System. By Prof. S. Ramón y Cajal. Translated and edited by Dr. Raoul M. May. In 2 volumes. Vol. 1. Pp. xx+396. Vol. 2. Pp. viii+397-769. (London: Oxford University Press, 1928.) 50*s*. net.

HIGH in the achievements of modern Spain must be ranked the development of a school of biological science which evolved from the work of the Madrid histologist, Prof. Ramón y Cajal. His perfections of the silver impregnation of nerve fibres so that their axis cylinder (or essential conducting element) could be revealed to microscopical observation, led to a long series of researches on the structure of the nervous system from about 1890 to the present time.

Prominent in these researches are those devoted to the study of degenerative and regenerative processes in the nervous system, and while many of the main conclusions and methods had become known outside Spain, yet the multitudinous detail, the wealth of experiment and deduction, remained, at any rate to most English-speaking histologists, unknown. There were several reasons for this, of which the more apparent are their publication in Spanish in journals enjoying small circulation,

and the publication of a limited number of copies of a work on the subject in Spanish, close before the outbreak of the War. The two volumes under review are the first English translation of this work.

The controversies over the polygenist and monogenist doctrines which took place in the first decade of this century have now only an historical interest. Nevertheless, the accumulated evidence collected in the first volume of this work not only provides a lasting memorial to the virile championship and establishment of the monogenist doctrine, but also is invaluable for all future work bearing on this subject. With a wealth of detail of fine critical microscopy, Prof. Cajal traced the replacement of damaged nerve fibre separated from its cell of origin. The detail of the process is so complex, the vagrancies of the wandering amœboid growing terminal so varied and multiple, that their unfolding and rationalisation by systematic experiment, clear cut and boldly planned, is a fascinating study.

The work of Ross Harrison in America still remains the crucial demonstration of the independence of the axis cylinder process, but the essential symbiosis of these two elements in their biological partnership depends for its illustration and proof on the findings of Cajal. Of the various hypotheses put forward to explain the re-establishment of conducting paths by regeneration, he comes now to favour a combination of the established attraction of the proliferated cell of Schwann, and the attraction of the end organ itself; to explain on one hand the obvious attraction that degenerated nerve has for regenerating processes, and on the other the occurrence of regeneration when no degenerated segment delineates the path of growth. These studies of the growing point of nerve fibres and its reactions appear to offer insuperable obstacles to any other explanation.

The second volume, dealing with the reaction of the nerve centre to injury, is, like the first volume, but even to a greater extent, a mine of information for all engaged on the physiology and pathology of the nervous system. It is only necessary, for example, to indicate the bearing of the complexity of collateral formation in neurones under "regenerative turgescence", on recent work by authors who, unmindful of these complexities of the subject, have adduced experiments on the dorsal nerve roots in support of efferent fibres (parasympathetic) in these roots. This exposition of the work of Prof. Ramón y Cajal and his school on the dorsal root ganglion cells throws considerable doubt on the widely accepted physiological hypotheses built round the pericellular plexuses of these cells described by Dogiel.

Outstanding features of the second volume are the description of the phenomena of degeneration in the cerebral and cerebellar cortex following interruption of the axis cylinder processes. The hypertrophy of collaterals and the atrophy of the damaged axon are of great significance both physiologically and pathologically. Cajal reaffirms his belief in the lack of regeneration in the central nervous system, although he adduces the experiments of Tello to show this lack is not in the neurone, but in the absence of Schwann's cell.

At the end of most of the chapters an additional note has been added summarising work which has appeared since the publication of the Spanish edition. These notes in most part fulfil their purpose, but one could wish that the chapter on neuroglia and its reactions had included the recent work of del Hortega, and that on the cerebellum, the work of Cajal himself on the newer silver methods for studying this cortex.

The book is admirably produced and includes a very large number of excellent illustrations portraying the wonderful contrasted effects which only the reduced silver method can produce. The translation is perhaps in some few places too literal to read comfortably, but is always intelligible. In three places "afferent" is used where "efferent" is evidently intended (p. 269, l. 3, p. 271, l. 7, p. 272, l. 7), and "sensory" is obviously intended for "motor" on p. 272, l. 29, and the reviewer would also suggest that Nissl "granules" is more common usage in English that Nissl "grumes". D. D.-B.

Our Bookshelf.

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, etc.; with Concise Methods for the Detection and Estimation of their Impurities, Adulterations, and Products of Decomposition. Vol. 7: *The Vegetable Alkaloids.* By the Editor, and the following Contributors: F. H. Carr, Oliver Chick, Norman Evers, J. J. Fox, T. A. Henry, P. J. Sageman, T. M. Sharpe, F. O. Taylor, R. W. Tonkin, and R. Whymper. Editor: C. Ainsworth Mitchell. Fifth Edition, Revised and Partly Rewritten. Pp. xi+869. (London: J. and A. Churchill, 1929.) 30*s*.

THE editor of this volume can rightly claim that it is a complete thesis on the analysis of the vegetable alkaloids. It shows improvement over the previous edition for reference purposes, as all the material

on this important section of organic chemistry is now collected and classified in one book, which includes the subject matter from Vol. 6 of the last edition on alkaloids generally, and on the volatile bases of vegetable origin, as well as the subject matter from Vol. 7 on the vegetable alkaloids. Special sections, arranged alphabetically, owing to the difficulty of chemical classification, are given to products of definite commercial importance in connexion with food and drugs (for example, caffeine, cocaine, nicotine, opium, etc., receive separate treatment). The other known alkaloids are systematically dealt with in a general introduction, again with alphabetical grouping. In the introduction the reactions and properties of the vegetable alkaloids as a group are also reviewed.

In contrast with the ordinary text-book, the drafting of a comprehensive technical thesis of this nature, with its great mass of specialised information, requires the assistance of many experts to make the venture a success. As a result, we find each section written by a specialist in that particular field. The whole work is ably edited by Mr. C. A. Mitchell, who also contributes the chapter on strychnos alkaloids.

There is lack of complete uniformity in the revision of material from the various editions of the British and foreign pharmacopœias; in some instances the latest data are not given, and there is want of agreement between the statements recorded. A number of typographical errors have also been noted, and in a few instances information that would be expected in such a volume has not been found. These slips and omissions, however, are probably not more than might be expected in a work of this nature. The book, which is printed in the United States, is excellently produced with regard to paper, type, and binding. J. REILLY.

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1930. Edited by George E. Brown. Pp. 784 + 64 plates. (London: Henry Greenwood and Co., Ltd., 1930.) 2*s.* net.

THIS welcome annual (for it is in no sense an almanac) again makes its appearance. The general arrangement is very much the same as heretofore. As this is the twenty-fifth year in which the present editor has had the arranging of it, the article which he contributes consists of his personal reminiscences (or some of them), which will be read with much interest. But we think that he has overstepped the mark to the detriment of the memory of Sir William Abney in stating that his various text-books display a pronounced disinclination to deal with the work of other investigators, and that therefore we have in English no comprehensive work similar to those of Eder in Germany and Fabre in France. Abney never attempted such a comprehensive work, although the editor states that "he was the one man to supervise" it, and perhaps the editor himself gives the reason when he says that "it was an obvious effort to him to present a subject in simple terms". If Great Britain "suffered from the Abney predominance", as stated here, that surely was the fault of his contemporaries, as this is a free country.

The volume includes the many items that we are accustomed to find in it, tables, formulæ, lists of addresses, new apparatus, and so on, and excellently reproduced gravure copies of photographs.

Essentials of General Physiology. By Prof. Eric Ponder. Pp. viii + 497. (New York, London and Toronto: Longmans, Green and Co., Ltd., 1929.) 15*s.* net.

THIS is a sound and clearly written text-book which should prove useful to students beginning physiology. The opening chapters, of an introductory character, are advisedly concerned with a plain description of surface phenomena, colloids, permeability, dissociation, and the action of enzymes; the student may already be conversant with these aspects of physical chemistry, but his interest will be maintained by the well-chosen biological examples. Equipped with these elements of physical chemistry, the reader is better able to appreciate the actual physical and chemical basis of the processes underlying vital phenomena.

The contraction of muscle, conduction in nerve, secretion, tropisms, digestion, respiration, and circulation are the branches selected by the author for treatment from the physico-chemical point of view. With the rapid and many-sided development of physiology, the subject is becoming so unwieldy that, if it is to be approached from a scientific point of view, there will have to be a complete inversion of the present order of study; this book constitutes a step in the right direction, since a grasp of the underlying general principles should precede a descriptive study of the phenomena of the usual human and mammalian physiology. As the book is intended mainly for beginners, perhaps more illustrations might be of value; this, however, is not a serious deficiency since the text is so lucid.

Les paysages catalans: leurs aspects, leur structure et leur évolution. Par Marcel Chevalier. (Aspects physiographiques de l'Espagne.) Pp. vi + 172 + 48 planches. (Paris: Albert Blanchard, 1929.) 30 francs.

THERE is comparatively little material available on the details of the geography of the Iberian peninsula. This study of the north-eastern corner of Spain is therefore welcome, although the author has dealt with little outside the purely physical aspects. Apart from the comparatively recent plains, M. Chevalier recognises three structural divisions in the mountains of Catalonia: The Pyrenees in the north with their exposures of ancient crystalline and palæozoic rocks; then the sierras of secondary and tertiary rocks of a newer topography with no evidence of glacial action; and then, lastly, the worn-down remnants of old Hercynian foldings. Structure and surface features are fully discussed. There are many illustrations and sketch maps. The book is an enlarged edition of a volume in Catalan that appeared recently.

Letters to the Editor.

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

Hydrogen-like Spectra of Lithium and Beryllium in the Extreme Ultra-violet.

In preceding communications (NATURE, Nov. 2, 1929, and *Comptes rendus*, Jan. 1930) we have given a brief account of the extension of the extreme ultra-violet down to 100 resp. 88 A. in the spectrum of doubly ionised beryllium (Be III). Using a vacuum-spark with a considerably increased capacity and ionisation power, it has now been possible to record the strongest radiations in the hydrogen-like spectra of completely ionised lithium (Li III) and beryllium (Be IV), thus extending optical spectra to 76 A.

According to the Bohr theory, a system consisting of a nucleus with the positive charge $e \cdot Z$ and a single electron will emit radiations with the following wave numbers (neglecting the slight correction for relativity):

$$\nu = Z^2 R\left(\frac{1}{n^2} - \frac{1}{m^2}\right) \text{ cm.}^{-1},$$

the Rydberg constant R being slightly dependent on the mass M of the nucleus. Thus,

$$R_M = R_\infty \cdot \frac{M}{m+M}, \text{ where } m = \text{the mass of the electron.}$$

Using Paschen's value for the Rydberg constant (Paschen-Götze, "Seriengesetze der Linien-spektren", Berlin, 1922) we obtain :

$M_H = 1{\cdot}008$	$R_H = 109\,677{\cdot}7$ cm.$^{-1}$
$M_{He} = 4{\cdot}0$	$R_{He} = 109\,722{\cdot}1$,,
$M_{Li} = 6{\cdot}9$	$R_{Li} = 109\,728{\cdot}6$,,
$M_{Be} = 9{\cdot}1$	$R_{Be} = 109\,730{\cdot}6$,,
	$R_\infty = 109\,737{\cdot}1$,,

The above relation gives for the spectrum of hydrogen the Paschen-Ritz series for $n = 3$, the Balmer series for $n = 2$, and the Lyman series for $n = 1$. The calculated wave-lengths of the first lines in the Lyman series are shown below. Several lines of this series have been found by Lyman, Hopfield, and others.

In the corresponding series of singly ionised helium (He II) Lyman found the first two members (*Astrophys. Jour.*, **60**, p. 1 ; 1924).

		HYDROGEN. λ calc.		HELIUM. λ calc.	λ obs.	Int.
$n=1$;	$m=2$	1215·68	$n=1$; $m=2$	303·80	303·6	2
	3	1025·73	3	256·33	256·3	1
	4	972·55	4	243·04		
	∞	911·76	∞	227·85		

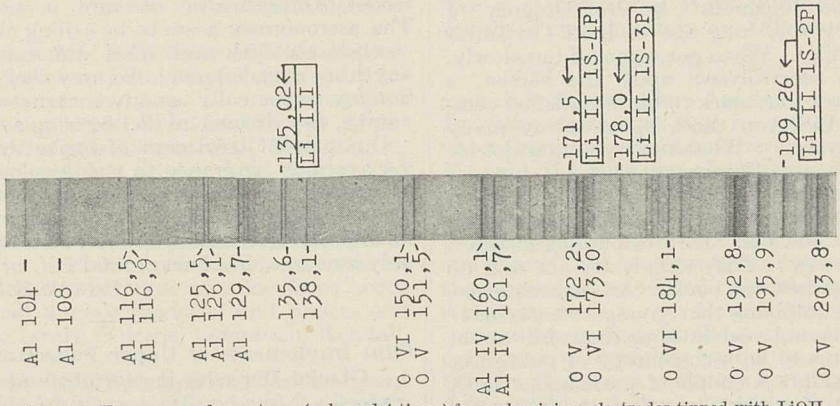

FIG. 1.—Vacuum-spark spectrum (enlarged 4 times) from aluminium electrodes tipped with LiOH. Time of exposure, 30 min.

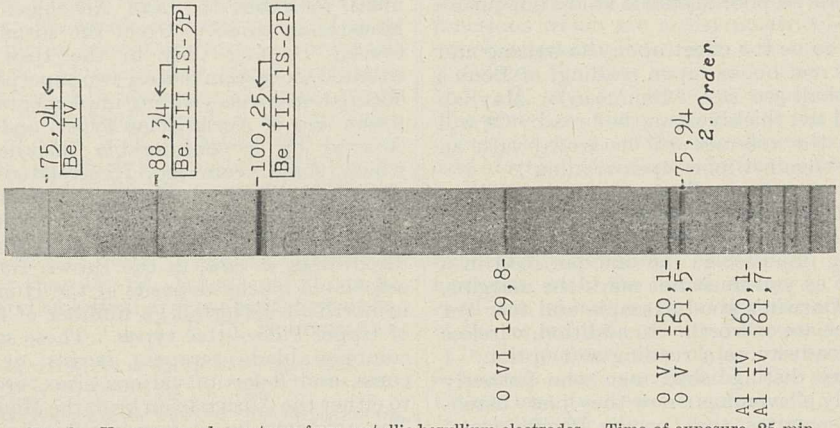

FIG. 2.—Vacuum-spark spectrum from metallic beryllium electrodes. Time of exposure, 25 min.

In doubly ionised lithium (Li III), which was hitherto not observed, we have measured the first two lines, the stronger of which was also obtained in the second order (Fig. 1).

Trebly ionised beryllium (Be IV) is revealed by the first member of the same series, which has been measured as well both in the first and second order (Fig. 2).

		LITHIUM. λ calc.	λ obs.	Int.		BERYLLIUM. λ calc.	λ obs.	Int.
$n=1$;	$m=2$	135·01	135·02	2	$n=1$; $m=2$	75·94	75·94	1
	3	113·92	113·93	0	3	64·08		
	4	108·01			4	60·75		
	∞	101·26			∞	56·96		

A detailed description of the apparatus and methods used in these experiments will appear in the *Zeitschrift für Physik*.

BENGT EDLÉN.
ALGOT ERICSON.

Physics Laboratory, University,
Uppsala, Dec. 19.

Book Prices and Reading.

"THE first of these 'little books on great subjects' is considerably shorter than the other two and costs five times as much [2*s*. 6*d*.] . . . it cannot be regarded as over-priced; it is rather the others that are extraordinarily cheap." One of the others is a Benn 6*d*., "Earthquakes and Volcanoes", by Prof. Gregory. I think of the story told long ago of Lant Carpenter lecturing at the 'Vic'. When gas came off but slowly, as 'water' was electrolysed upon the screen, a galleryite was heard to remark to his dissatisfied companion: "Well, Bill, you can't 'spect to 'av many bubbles for a a'penny". What can't you now get for 6*d*. from either Benn or Woolworth?

I have quoted from "Our Bookshelf", in NATURE of Jan. 4. On previous pages I see books are noticed priced at 18*s*., 21*s*. and 14*s*. How can students afford to buy at such prices? They simply do not and do not read; they only use cram books. As a consequence, Principal Tizard complains that young 'researchers' are uncultured; having read nothing, they also cannot write. There seems to be a conspiracy of publishers to repress authorship. A couple of years ago, a book of mine appeared of which I can say—adopting the Shavian principle that self-praise is the only recommendation—that it was dear at 8*s*. but at 7*s*. 6*d*., the price at which the publisher led me to believe that it would be issued, it was as well worth a student having as any Shavian romance up to 10*s*., if only for the dedication; it was issued at 15*s*. and killed. Is it worth the publishers' while to kill at 15*s*. when they might maintain in healthy activity at half the price? Prof. Bone's Vol. 3 on "Combustion" costs two guineas. How can we poor chemists study our future fate at such price?

What is going to be the effect upon the writing and upon the sale of real books, upon reading, of Benn's pemmican—or shall we say, 'Bennican'? Mayhap the jam is spread too thickly upon the bread. Or will it be, that, soon, the volumes will be issued with an insurance ticket—against more open reading?

To-day you do not get any discount on your shilling. Scientific journals, especially German, are sold at prohibitive prices. Reading is not merely a disappearing art but becoming impossible: no one can read in a library, the more as you must not mark the margins, let alone follow Darwin's good example and tear out the few pages that are of worth. In addition, wireless is fast making headway as a reading soft-option. I know of two very distinguished men who formerly read omnivorously o' evenings: now they just 'listen-in'. My daughter writes, that, on the Pacific coast, the theatre is deserted, because the effort of listening and attending to the play is too much for the boys—'the pictures' have reduced them to mental somnolency. Why was not the recent London Opera Festival properly supported by the public? The performances were more than interesting. Was not the price too high? Art lovers are as poor as are artists. Is science, as wireless, in the hands of a few, to kill the intelligence of the many?

Into whose pocket is the book-money going? Sir Ernest Benn is a great exponent of economics—has he at all fully studied the intimate economics of the bookshelf? The policy of failing to encourage good books, other than those written by popular favourites or shockers? He might well call, say, Marie Stopes, Mr. Wells, the author of "All Quiet", into conference. It would be interesting to hear from him what his Woolworth series is doing. It is a fine effort.

Truth is being withheld from the public—we only play with it. Take biblical criticism. Is it not *our duty* to present its results dispassionately, in clear readable form, even to the young? We seem now to be agreed that the mysteries of sex shall be displayed to the adolescent. We are still afraid openly to discuss the foundations of the faith that is forced upon so many.

Chemistry is in dire need of critical discussion: we have not a single work that is broadly critical. A recent Americanistic attempt is not encouraging. The astronomers seem to be sailing close to the wind—when the fifth and other dimensions come along anything may happen: we may then have what my Sunday paper calls 'gaudy incarnations of common vanity, day dreams *ad lib*.' figuring as science.

Our present treatment of books threatens to be a very serious hindrance to the development of habits of sound scientific thought, indeed of scientific progress. Naughty ones seem to sell, whatever the price; nice ones do not. Are we all to be forced to be naughty, only nice in a dim background?

HENRY E. ARMSTRONG.

Flint Implements of Upper Palæolithic Types from Glacial Deposits in Norfolk and Yorkshire.

MY researches in East Anglia have demonstrated that palæolithic flint implements occur in the glacial Boulder Clays of this region, and that these deposits, and their contained artefacts, are of widely differing ages. Thus, in the Tills overlying the Cromer Forest Bed of Norfolk, have been discovered specimens of Chellean type,[1] while, in what I term the Upper Chalky Boulder Clay of Suffolk, which appears to be separated from the Cromer Tills by a series of sands, gravels, and brick-earths, I have found specimens referable to Late Acheulean and to Early Mousterian times.[2] Upon the surface of the Upper Chalky Boulder Clay in the Ipswich district are situated, at certain places, two superposed and ancient occupation-levels yielding implements of Upper Mousterian and of Aurignacian types, and these floors are covered by a considerable thickness of hill-wash which, some years ago, I correlated with the latest glacial conditions obtaining in Suffolk.[3]

Recently, during a research carried out under a grant from the Percy Sladen Memorial Fund, I have discovered, *in situ*, in the Brown Boulder Clay, and associated glacial deposits of the Hunstanton district in north-west Norfolk, a number of flint implements of Upper Palæolithic types. These specimens, which comprise blade scrapers, *burins*, or graving tools, cores, and flakes of various sizes, are to be referred to either the Aurignacian or to the Magdalenian epoch. The artefacts lie at varying depths in the deposit, which is often rich in erratic rocks, and a number of them exhibit definite striations. The Brown Boulder Clay is fully described in the Geological Survey memoirs[4] dealing with the area examined, and the sections from which I have recovered my specimens are classed by the surveyors as of glacial origin. It is, however, necessary to point out that, while in the memoirs mentioned, the possibility, from a geological point of view, of the Brown Boulder Clay being of later date than the chalky variety of the district is suggested, no decision upon this important matter was reached by those who conducted the survey in north-west Norfolk. My researches, nevertheless, lead me to believe that the

Brown Boulder Clay, judging from the artefacts it contains, is clearly later than the chalky form.

Further, the discoveries in north-west Norfolk (which are to be described before the Society of Antiquaries on April 3 next) support, very strongly, the conclusions I had come to regarding the glacial origin of the hill-wash overlying the floors, above mentioned, in the Ipswich district.

Following upon the initial stages of my work in Norfolk, Mr. J. P. T. Burchell has carried out researches in Yorkshire, which confirm, in a striking manner, the archæological results obtained by me farther south, and it now seems possible to form an accurate and complete picture of the relationship of the various palæolithic industries to the glacial deposits of England.

J. REID MOIR.

FOLLOWING upon Mr. Reid Moir's notification to me that he had discovered flint implements of Upper Palæolithic types, at the base of, and scattered throughout, the uppermost Boulder Clay of north-west Norfolk in the neighbourhood of Hunstanton, I determined to conduct similar investigations in a locality situated considerably farther northward. The area I chose for examination comprised the intensely glaciated districts of Holderness and Flamborough Head in Yorkshire. Detailed descriptions of the glacial deposits of these two localities occur both in Geological Survey Memoirs[5] and papers and books by Carvill Lewis, Dakyns, Lamplugh, Kendall, and others.[6]

The researches, which I carried out under a grant from the Percy Sladen Memorial Fund and the Society of Antiquaries, resulted in the discovery, *in situ*, of a considerable number of flint implements of Upper Palæolithic types at the base of the uppermost Boulder Clay of the area. This deposit contains an abundance of erratics, largely consisting of North British and Scottish rocks. Similar implements I found scattered freely throughout this Boulder Clay, many of which show marked striations. This industry, which consists, for the most part, of flake implements struck from tortoise-cores, I would refer to Upper Mousterian-Aurignacian times. The specimens comprise hand-axes, scrapers, gravers, blades, knives, and tortoise-cores both struck and unstruck. This discovery, which indicates a complete deglaciation of Holderness and Flamborough Head during the Pleistocene period, is of particular interest in view of Prof. J. K. Charlesworth's paper of September last,[7] in which it is postulated that the terminal moraine which builds a gravel ridge on Flamborough Head and is traceable through Holderness to its south-easternmost portion (the Cromer ridge) is Magdalenian in date. That the moraine in question is earlier than the St. Acheul period can be proved both on archæological and geological grounds.

J. P. T. BURCHELL.

[1] *Antiquaries Journal*, vol. 91, No. 2, pp. 135-137; April 1923.
[2] *Jour. Roy. Anthr. Inst.*, vol. 50, pp. 135-152; January-June 1920.
[3] *Jour. Roy. Anthr. Inst.*, vol. 47, pp. 367-412; 1927.
[4] "The Geology of the Borders of the Wash." "The Geology of the Country around Fakenham, Wells, and Holt."
[5] "The Geology of Holderness." "The Geology of Bridlington Bay."
[6] Glacial Geology of Gt. Britain; Carvill Lewis. *Proc. Geol. Soc. Yorkshire*, n.s., vols. 7 and 8. *Quart. Jour. Geol. Soc.*, vol. 47, pp. 384-431; 1891. "The Geology of Yorkshire", Kendall and Wroot, 1924.
[7] *Quart. Jour. Geol. Soc.*, vol. 85, pp. 335, 359; 1929.

On the Correct Formulation of Pauli's Exclusion Principle.

PAULI'S 'Exclusion Principle' applied to the simplest case of the two-electron or two-proton system (helium atom, hydrogen molecule) is usually stated as follows: if the electrons (or protons) are parallel, that is, if their spins point in the same direction, their eigenfunction must be antisymmetrical with respect to the co-ordinates; if the electrons (or protons) are antiparallel, that is, pointing in opposite directions, their eigenfunction must be symmetrical.

I wish to point out that this formulation of Pauli's principle is erroneous. There is actually no direct relation between the symmetry character of the eigenfunctions (as functions of the co-ordinates alone) and the orientations of the electrons (or protons). In every stationary state of a single electron with a given energy E, *both* orientations are in general possible, although they have different probabilities (in the same way as the different values of the co-ordinates). In Pauli's theory of the spinning electron (*Zs. f. Phys.*, **43**, p. 601; 1927) these probabilities can be defined by means of two eigenfunctions $\psi_\alpha(x, y, z)$ and $\psi_\beta(x, y, z)$ which are the solutions of a system of two simultaneous differential equations

$$H_{\alpha\alpha}\psi_\alpha + H_{\alpha\beta}\psi_\beta = E\psi_\alpha, \quad H_{\beta\alpha}\psi_\alpha + H_{\beta\beta}\psi_\beta = E\psi_\beta$$

replacing Schrödinger's 'scalar' equation $H\psi = E\psi$. To every eigenvalue, that is, energy-level, E_μ, of the latter there correspond *two* energy-levels of the former, $E_\mu{}^+$ and $E_\mu{}^-$ with the eigenfunction-couples $\psi_\alpha{}^+$, $\psi_\beta{}^+$ and $\psi_\alpha{}^-$, $\psi_\beta{}^-$ respectively, $\int|\psi_\alpha{}^\pm|^2 dv$ being the probability of one and $\int|\psi_\beta{}^\pm|^2 dv$ of the other orientation.

In the limiting case of a very strong magnetic field one gets $\psi_\beta{}^+ = \psi_\alpha{}^- = 0$,—whence the confusion between the type of orientation (α, β) and the character of the stationary state ($\pm$). As a matter of fact, these are quite different notions, the $\pm$ character of the state in question corresponding to the two possible values of the fourth (inner) quantum number, introduced by Sommerfeld and Pauli for the complete specification of the electronic orbits.

Now Pauli's principle (in its original corpuscular form) requires that there should not be in the same atom two or more electrons with the same values of all the four quantum numbers. This does not, however, imply—except in the case of a very strong magnetic field—that two electrons (or protons) with identical orbits should have opposite orientations.

The wave mechanical formulation of Pauli's principle, due to Dirac, amounts to a restriction to functions which are antisymmetrical with respect to variable-quadruples x, y, z, σ for different electrons; σ denotes the spin variable taking two values, $+\frac{1}{2}$ and $-\frac{1}{2}$, say, for α and β respectively (and being interpreted as the projection of the spin-moment in $h/2\pi$ units on one of the co-ordinate axes). Thus in the case of n electrons a wave function $\psi(x_1, y_1, z_1, \sigma_1; \ldots; x_n, y_n, z_n, \sigma_n)$ for a given stationary state represents actually a complex of $2n$ functions of the co-ordinates alone, corresponding to all possible (but in general not equally probable) orientation types of all the electrons with the same energy. These functions need not, of course, be antisymmetrical with respect to the co-ordinates of the different electrons.

In the simplest case of two electrons which, taken separately, are specified by the eigenfunctions (or rather eigenfunction-couples) $\psi(r_1, \sigma_1)$ and $\phi(r_2, \sigma_2)$ (r standing for x, y, z), the stationary state admitted by Pauli's principle is described in the first approximation by the function (or function-quadruple) $\frac{1}{\sqrt{2}}[\psi(r_1, \sigma_1)\phi(r_2, \sigma_2) - \psi(r_2, \sigma_2)\phi(r_1, \sigma_1)]$. Taking for ψ and ϕ the two functions $\psi^\pm$ and $\phi^\pm$ considered above, we get *four* stationary states if ψ and ϕ correspond to different orbits (in Schrödinger's sense), and only *one* state in the opposite case, with definite probabilities both for the antiparallel and parallel spins.

In Dirac's theory of the electron each state is specified not by two but by four functions, two of them (ψ_α, ψ_β, say) being large and the other two (ψ_γ, ψ_δ) small. This can be interpreted by introducing along with

the two real eigenvalues of the electron's magnetic moment (or rather its projection on a given axis) $\pm\frac{he}{4\pi mc}$, two *imaginary* eigenvalues $\pm\sqrt{-1}\frac{he}{4\pi mc}$, which can be easily shown to correspond to two real values of the *electric* moment (or its projection) associated with the electron's spin (the electric moment in the corpuscular interpretation is equal to the magnetic one multiplied by $\sqrt{-1}$). The smallness of ψ_γ, ψ_δ with respect to ψ_α, ψ_β corresponds to the fact that the real part of the electric moment is equal to that of the magnetic one multiplied by v/c, v being the electron's velocity and c that of light.

J. FRENKEL.

Physico-Technical Röntgen Institute,
Leningrad, Dec. 30, 1929.

Rate of Vaporisation and Vapour Pressure: A Method of Measuring the Specific Area of a Surface.

LANGMUIR (*Phys. Rev.*, **2**, 329; 1913) has developed a method for the determination of the vapour pressure of metals from measurements of the rate of vaporisation of metallic filaments *in vacuo*. The vapour pressure is calculated from the Knudsen equation,

$$p = m\sqrt{\frac{2\pi RT}{M}} \quad . \quad . \quad . \quad (1)$$

where m is the rate of evaporation *in vacuo*, after making the assumption, which Langmuir supports with a considerable amount of experimental data, that the accommodation coefficient is unity. In this way he determined the vapour pressure at high temperatures, first of tungsten (loc. cit.) and later, with other workers, of platinum, molybdenum, silver, gold, copper, and nickel (Jones, Langmuir, and Mackay, *ibid.*, **30**, 201; 1927).

In order to determine the rate of vaporisation from unit area of the filament, Langmuir also assumes tacitly that the specific area of a metal surface is equal to the apparent area. This assumption is, however, in general, not justifiable for irregularities of atomic dimensions are present to a greater or lesser extent in all surfaces. (See Bowden and Rideal, *P.R.S.*, A, **120**, 80; 1928. Zwicky, *Proc. Nat. Acad. Sci.*, **15**, 253; 1929. Constable, *P.R.S.*, A, **119**, 196; 1928.) The work of Bowden and Rideal demonstrates that the specific area in suitable circumstances may be many times greater than the apparent area.

The error involved in the vapour pressure measurements from this assumption may be calculated quite easily. Let m' equal the measured rate of vaporisation from unit 'apparent' area: then

$$p' = Km',$$

where K is a constant given by (1) and p' is the vapour pressure as determined by Langmuir. Now if A is the ratio between the specific and apparent areas, the true rate of vaporisation from unit specific area is m'/A; and the true vapour pressure p is given by

$$p = \frac{Km'}{A},$$

that is

$$p' = Ap.$$

The values of the vapour pressure determined by Langmuir's method will, therefore, be too large by a factor equal to A. Further, the values of the chemical constants calculated from Langmuir's data appear to show that at least in the case of tungsten and molybdenum this correcting factor may be quite large, for the deviations from the theoretical chemical constant are $+1{\cdot}40 \pm 0{\cdot}50$ for tungsten, $+3{\cdot}02 \pm 0{\cdot}50$ for molybdenum, and $-0{\cdot}25 \pm 0{\cdot}40$ for platinum. *If* these deviations are to be attributed *exclusively* to the factor A, it would appear that while in the case of platinum the specific and apparent areas are approximately equal, in the case of tungsten the former is approximately five times the latter, and in the case of molybdenum twenty times. For the determination of the vapour pressure from the rates of vaporisation it is, therefore, necessary to know A accurately. It is important to note that A is a measure of the area accessible to condensing molecules of the vaporising solid. This is likely to be very different from the value of A determined, for example, by the method of Bowden and Rideal, which measures the area of a surface accessible to hydrogen ions.

We have so far been concerned with the possibility of the determination of the vapour pressure from the rate of vaporisation, given that A is known. It is quite clear, however, that the converse can be carried out: that is, knowing the true vapour pressure and the rate of vaporisation to determine A, since A is simply the ratio p'/p of the vapour pressure p' calculated from the rate of vaporisation to the true vapour pressure p. Moreover, since the true vapour pressure p can be measured accurately by some equilibrium method, such as the Knudsen effusion method, and p' can often be determined accurately from the rates of vaporisation, we have a fairly exact method for measuring A which is capable of extended application.

F. J. WILKINS.

Laboratory of Physical Chemistry,
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Jan. 16.

The Classification of the Primates.

MR. TATE REGAN'S letter in NATURE of Jan. 25 on the classification of the Primates, with special reference to the microstructure of the dental enamel, again raises the vexed question of Primate phylogeny. Attention has lately been redirected to this problem by the reiteration of the 'unorthodox' opinions of two eminent anatomists, H. F. Osborn and F. Wood Jones.

A consideration of the conflicting points of view regarding the origin of the human stem will, I think, reveal that there are two sources of confusion which tend to prevent a lucid survey of the problem, (1) an arbitrary use of the conception of irreversibility of evolution, and (2) the careless employment of a nomenclature which is often insufficiently defined.

As regards the first point, it is to be noted that, in the absence of an abundant palæontological record, the construction of a phylogenetic tree must depend almost entirely upon a study of comparative anatomy, with a proper appreciation of the distinction between primitive or generalised, and specialised anatomical characters. If, in the interpretation of the anatomical data, reliance is placed on the 'law' of irreversibility of evolution, it is possible, by a sort of theoretical triangulation, to infer the nature of the common ancestor of the existing members of a natural group. But if the 'law' of irreversibility be accepted at all as a basis for argument, it should be carried to its logical conclusion unless strong evidence to the contrary is forthcoming in exceptional cases. Further, if *all* the available anatomical evidence is taken into account, such lines of argument will inevitably lead to the conclusion that the Catarrhines cannot have been derived from the Lemuriformes (Lemuroidea of Mr. Tate Regan)—as the 'Lemuriformes' are commonly defined, nor can the Platyrrhines have been derived from the Tarsioidea—as the 'Tarsioidea' are commonly defined.

In regard to the second point, the adoption of a

loose terminology in some expositions of man's evolutionary origin has evidently been the cause of much profitless controversy. Terms such as 'gorilloid', 'anthropoid', 'tarsioid', and 'lemuroid', are constantly being used by different authors with different connotations. It is not permissible, for example, to talk of the 'gorilloid heritage' of man, for the term 'gorilloid', unless specifically defined otherwise, can only be interpreted as an adjectival form of the word 'gorilla' which refers to an anthropoid ape with specialisations such as few anatomists can believe to have been features of the precursor of the human stem. The term 'anthropoid ape', also, by its common definition, implies an arboreal animal showing certain adaptive specialisations which would presumably be absent from any form ancestral to man. Unless, therefore, the term 'anthropoid ape' be given a wider application than it is usually accorded, it is highly questionable whether it is legitimate to say that man has ever evolved from a form which can be strictly called an anthropoid ape. Opponents of the theory of the 'anthropoid' origin of man may, in this case, be justified in their criticisms even though they may be derided for basing the latter on what appears to be a verbal quibble. Similar criticisms apply to the terms 'lemuroid' and 'tarsioid'.

As Mr. Tate Regan implies, the interpretation of the available data in regard to the classification of the Primates is a matter of great difficulty, and largely depends upon the taxonomic value accorded to different anatomical characters by different authorities. But the problem is rendered the more difficult by the lack of a precise definition of the nomenclature commonly employed in its discussion.

W. E. LE GROS CLARK.

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A Relation between Ultra-violet Absorption Spectra and Heats of Combustion.

THE ethylene linkage in the aliphatic hydrocarbons is characterised by two ultra-violet bands; an intense one 1800-1900 A., and one of low intensity between 2200 and 2600 A. (Stark et al., *Jahr. Rad.*, **10**, 139; Luthy, *Zeit. Phys. Chem.*, **107**, 285; Carr, *J. Am. Chem. Soc.*, **51**, 3041). The thermal equivalents ($Nh\nu$) of the two middle positions are 154·0 and 118·8 Kcal. and the difference is 35·2 Kcal.; this is almost identical with the difference in heats of combustion between a saturated hydrocarbon and the corresponding olefine, which for the first five members of the series is 36·8, 36·1, 36·2, 39·9, 37·2 Kcal. (Kharasch, *Bur. Stand. Jour. Research*, **2**, 359). The average value for the thermochemical characteristic of the C-C and C-H linkage in the liquid state is 52·1 Kcal. The heat of combustion of an hydrocarbon (liquid state) containing m double bonds can be represented by

$$Q = (3n + 1)52{\cdot}1 - m(Nh\nu_2 - Nh\nu_1)$$

where ν_1 and ν_2 are the centres of the absorption bands. For example, Q, calculated from Stark's data for diallyl, is 926·7 Kcal.; experimental, 921·1.

The only spectral measurements of acetylene hydrocarbons for which thermal data are available are those of Henri for acetylene and Stark and Lipp for acetylene and dipropargyl which are summarised as follows:

	λ max.	$\Delta Nh\nu$	$Q_1 - Q_2$
HC≡CH	2631		
	2040	31·4	60·1 = 2 × 30·0
$(HC{\equiv}C-CH_2-)_2$	2450		
	2010	25·5	114·4 = 4 × 28·6

The general formula would be:

$$Q = (3n + 1)52{\cdot}1 - 2m(Nh\nu_2 - Nh\nu_1)$$

where m is the number of triple bonds in the molecule.

On the assumption that the band in the short ultra-violet is related to the activation energy of the C – C or C – H linkage, calculations were made for the aliphatic alcohols. In ethyl alcohol Leifson (*Astrophys. Jour.*, **63**, 73) found six equally spaced bands between 2039 and 1892 A. with the centre at 1952 A. For alcohols in a homologous series the band is shifted 20 frequency units for each CH_2 (Henri's results). For the first four alcohols $\Delta Nh\nu$ (calculated from Bielecki and Henri's measurements) is 18·8, 18·3, 18·8, 20·4 Kcal.; $Q_1 - Q_2$ is 37·8, 37·0, 38·3, 39·8, therefore $Q_1 - Q_2$ is equal to $2 \times \Delta Nh\nu$.

By assuming for the aldehydes and ketones an analogous band near 1900 A., the value of $\Delta Nh\nu$ for seven ketones is 48·2 Kcal.; $Q_1 - Q_2$ is 96·6 or $2 \times 48{\cdot}3$; in three aldehydes $\Delta Nh\nu$ is 46·3 Kcal. and $Q_1 - Q_2$ is $87{\cdot}5 = 2 \times 43{\cdot}8$. For compounds containing three different types of linkage the calculated values compared with experimental (in parenthesis) are, in Kcal.: allyl alcohol 435·8 (442·4); croton aldehyde 537·7 (542·1); mesityl oxide 844·3 (846·7); allyl acetone 869·0 (856·7); citral 1439·3 (1437·0).

A more extended treatment together with the theoretical interpretation of the relationship will appear shortly elsewhere.

EMMA P. CARR
(A.A.U.W. Fellow).

Physikalisch-chemisches
Institut der Universität,
Zürich, Jan. 16.

Raman Effect with Optically Active Substances.

IT is already known from various investigations that the different isomeric forms of organic molecules give strikingly different Raman spectra. A noteworthy case is that of the cis- and trans- forms of dichlorethylene, which have been studied by Bonino and Brüll (*Zeit. für Physik*, **58**, p. 194; 1929). These investigators have found that the most striking differences appear in the characteristic molecular

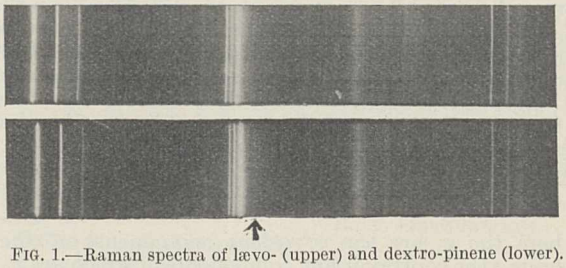

FIG. 1.—Raman spectra of lævo- (upper) and dextro-pinene (lower).

frequencies lying in the remote infra-red and made so readily accessible to observation by the Raman method.

It is evidently of great theoretical importance to ascertain whether optical isomers, that is, the dextro and lævo rotatory forms of the same molecule, give spectra which differ in any respect. To test this question, the two optically isomeric forms of pinene were examined. The materials as supplied by Kahlbaum were carefully purified by fractionating at constant boiling point (154° C.). All the numerous Raman lines which appear in the scattering by the dextro isomer are also observed with the lævo form and vice versa, and in identically the same positions, as we should expect. There are, however, appreciable differences in the relative *intensities* of some of the lines. This is particularly conspicuous in the case of

the Raman line corresponding to an infra-red wavelength of about 74μ marked by an arrow in the photographs reproduced in Fig. 1, which is conspicuous in the dextro form and scarcely visible in the lævo form. This result is sufficiently surprising, and is therefore put forward with all due reserve. Nevertheless, the authors feel reasonably confident of its reality.

Further work has been undertaken to study other optically active substances (both fluid and crystalline). It is also proposed to investigate whether the state of polarisation of the light has any influence on the observed results.

S. BHAGAVANTAM.
S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, Dec. 28, 1929.

The Gibbs-Ewald Reciprocal Lattice.

THE Gibbs-Ewald reciprocal lattice is now of such general use in the discussion of problems in crystal physics that it seems worth while to record a simple analytical expression for its definition.

The usual vector definition of the reciprocal lattice is expressed by the relations [1]

$$(\mathbf{b}_i\mathbf{a}_i)=1 \qquad (\mathbf{b}_i\mathbf{a}_k)=0 \qquad i\neq K,$$

where $\mathbf{a}_i$ refers to the vector defining any one of the primitive triplet of translations of the crystal lattice; and $\mathbf{b}_i$ refers in a similar way to the primitive triplet of the reciprocal lattice.

I now suggest an equivalent formula of a purely analytic type. Let us consider the equation

$$l^{2\pi i\sum_1^3 u_i x_i}=1,$$

and discuss the simple case in which the x_i are the co-ordinates of a point referred to orthogonal axes. We now consider another space referred to similarly situated axes in which the co-ordinates of a point are u_i. To every point u_i in the second space, there corresponds an infinite number of planes

$$u_1x_1+u_2x_2+u_3x_3=n,$$

where n is an integer. The distance between any two adjacent planes is equal to $n/(u_1^2+u_2^2+u_3^2)$. If now we apply the law of rational indices to specify the crystallographically possible planes, we see that the values of u_i are then the co-ordinates of the points of the reciprocal lattice as usually defined.

For the discussion of the case of oblique axes, the tensor form of the equation is probably the simplest. We write immediately

$$l^{2\pi i x_i x^i}=1,$$

where the x_i are the covariant components of the vector x the contravariant components of which are x^i. The co-ordinates in the reciprocal space can then be associated directly with the covariant components of the co-ordinate vector in the original space.[1] In the use of the tensor form it is interesting to make use of an affine co-ordinate system [2] of constants a, b, c, and angles α, β, γ, appropriate for the crystal under discussion.

I hope to develop the present transformation and also the more general transformation expressed by the equation $F(x_ix^i)=0$ in connexion with the Fourier integral transformation previously published.[3]

A. L. PATTERSON.
Rockefeller Institute for Medical Research,
New York City.

[1] P. P. Ewald: "Handbuch der Physik", **24**, 241 (Springer, 1927).
[2] E. Madelung: "Mathematische Hilfsmittel des Physikers", p. 85 (Springer, 1925).
[3] A. L. Patterson: *Zeits. f. Phys.*, **44**, 596; 1927.

The Blowfly's Mouth.

THE proboscis of the blowfly has been so often figured and described that students generally have no difficulty in understanding its structure and mode of working. There is, however, one small ambiguity that beginners are liable to find somewhat perplexing, especially when only balsam preparations are used, namely, the use of the word mouth to describe the opening in the centre of the terminal disc. That this opening is not the mouth in the sense of being the entrance to the pharynx is apparent when one dissects a well-distended proboscis that has been cleared in potash. If the disc is snipped off and examined under water without pressure (see Fig. 1), the opening is

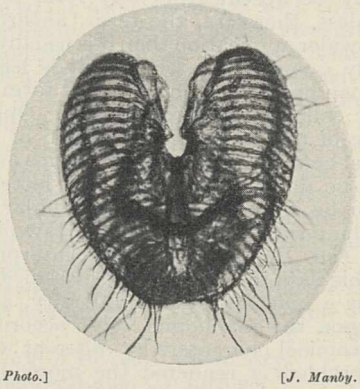

Photo.] [*J. Manby.*

FIG. 1.—Disc of blowfly's proboscis.

found to be identical with the gap lying between the two lobes (*labella*), particularly with the small central region, which is nearly but not quite partitioned off from the upper part and which is continuous behind with the channel-like groove in the haustellum.

If the name mouth is retained for this region of the disc, the question arises what the aperture at the other end of the haustellar groove should be called. Unlike the gap in the disc, this small and deeply placed aperture is concealed from view and somewhat troublesome to find unless the overlying parts be first removed. When this is done—when, for example, the haustellum is cut away—the aperture is seen lying between the epi- and hypopharynx at the end of the rostrum; and since, besides being associated in this manner with appendages that are plainly oral in character, it opens directly into the front portion ("buccal cavity", Patton and Cragg) of the pharynx there seems to be good reason why it, rather than the opening in the disc, should be called the mouth.

T. H. TAYLOR.
The University,
Leeds.

Organic Chemistry at University College, London.

IT is now an open secret that the Academic Council of the University of London is being moved not to appoint an eminent organic chemist to succeed Prof. Robinson in the chair of organic chemistry in University College, London, but to fill the two chairs of chemistry in this institution by distinguished physical chemists. The acceptance of such a fantastic proposition would disturb the balance of natural philosophical studies in University College so profoundly that immediate public protest is necessary, and the more so in that organic chemistry is not directly represented on the Academic Council.

Physical chemistry is a modern subject; its achievements, based, on one hand, upon the recent rapid

developments in physics, and, on the other, upon the vast accumulation of experimental facts of inorganic and organic chemistry, have led to great advances in pure and applied chemistry. But when the pure physics and the pure chemistry are removed, little is left of physical chemistry as an individual science. This border line subject, indeed, could not exist without its essential props of physics and chemistry.

Meanwhile, organic chemistry pours out, through its research workers, a stream of new facts far broader than that issuing from physical chemistry: its problems, particularly of biological significance, are becoming more fascinating and more profound, and its experimental technique is growing in intricacy and certainty. The Royal Society continues with fair regularity to elect annually one organic chemist and one from the inorganic or physical side to its fellowship; the great chemical societies, the world over, still publish many more papers on organic than on physical chemistry. It is becoming increasingly more difficult to find young organic chemists to meet the ever-growing needs of the research laboratories in our great industrial organisations.

Until the advent of the day when the mathematical physicist shall have rendered obsolete the experimental worker in inorganic, organic, and physical chemistry, and indeed also in physics and biology, the suppression of the chair of organic chemistry in so broad a science school as that of University College, London, will be an academic disaster.

W. J. POPE.

Cambridge, Feb. 8.

SIR WILLIAM POPE'S letter raises an issue of such importance to the future of chemistry in Great Britain that every effort should be made to place the position before the University authorities before any final and irrevocable step is taken.

During the last decades of the past century the condition of organic chemistry in Great Britain was such that many of our younger chemists had to go to one or other of the great continental universities to learn the science. At the present time all that is changed, and schools of organic chemical research are established in all our chief universities. From these, as Sir William Pope has said, there issues a steady stream of published research comparable in quality and quantity with that emanating from any other country. We must, therefore, be careful not to take any action which may set the clock back forty years and lead to a state of affairs which will again place us in the hands of the great research schools abroad.

Indeed, it is almost incredible that this could now happen, although a retrograde action, such as that mentioned in Sir William Pope's letter, would undoubtedly deal a serious blow to organic science by preventing the more brilliant of the younger men from adopting a branch of chemistry which was considered in some quarters to be moribund. Such a view is, moreover, so alarming that unless one had heard it expressed in conversation one would hesitate to trouble readers of NATURE by suggesting that any justification of organic chemistry is either necessary or desirable.

Nevertheless, the people who have to decide these grave issues are not necessarily chemists, and a short article in NATURE dealing with the present position and prospects of organic chemistry would certainly bring enlightenment to many. Advantage of the occasion might also be taken to refer to the admirable address given by the president of Section B at the recent South African meeting of the British Association. I should add that I am writing this letter in my personal capacity and not as president of the Chemical Society.

JOCELYN THORPE.

Royal College of Science,
South Kensington,
London, S.W.7.

X-Ray Measurements with a Plane Diffraction Grating.

RECENTLY Prins [1] computed the Porter-correction [2] for Bearden's wave-length value,[3] and found it amount to half the difference between Bearden's value and that obtained from crystal measurements, which is 0·23 per cent.

1. With some necessary assumptions I have computed the same correction to 0·0007 per cent for Bearden's and to 0·002 per cent for my own value,[4] which was also mentioned.

2. It is to be noticed that this correction increases the difference, and that the function of the slits in these cases only is to screen off sufficiently narrow beams.

3. Effects as those calculated by Fagerberg [5] also seems to have had little influence on my value. Variations in the wave-lengths which may depend upon such variations of the grating constant, could not be observed. As already indicated in my dissertation, the variations obtained were all explainable as accidental errors in the measurements of the plates.

ERIK BÄCKLIN.

Physics Laboratory,
Uppsala.

[1] J. A. Prins, NATURE, Sept. 7, 370; 1929.
[2] A. W. Porter, *Phil. Mag.*, **5**, 1067; 1928.
[3] J. A. Bearden, *Proc. U.S. Nat. Ac. Sci.*, **15**, 528; 1929.
[4] E. Bäcklin, Inaug. Diss. Uppsala Universitets Årsskrift, 1928.
[5] S. Fagerberg, NATURE, Jan. 4, p. 13.

Dr. Sebastian Z. de Ferranti.

DR. FERRANTI was a valued member of the National Physical Laboratory Committee entrusted with the supervision of the experiments made possible by the use of the high tension equipment supplied by his firm. We shall miss his advice greatly. There is, however, a slip in the admirable account of his work in NATURE for Feb. 1, p. 172, which he would have been the first to wish to see corrected. According to the Report of the High Tension Committee, printed in the Report of the National Physical Laboratory for 1928, p. 163, "The high voltage transformers were supplied by Messrs. Ferranti, Ltd., to the design of Messrs. E. Haefly and Co., S.A. of Bâle, who constructed certain parts".

R. T. GLAZEBROOK.

Ballards Oak, Limpsfield,
Surrey, Feb. 3.

"Encyclopædia Britannica."

IN volume 22 of certain sets of the new edition of the "Encyclopædia Britannica" there is an article on Tides, beginning at the foot of page 193 and ending in the first column of page 204. In the list of authors this article is ascribed to me, and it is true that it is founded on a MS. prepared by me. But I am not responsible for the article as it is printed, and I should be very grateful to be allowed to use the columns of NATURE to say so.

I am informed by the publishers that other sets of the 'Encyclopædia' contain a very different article, of which I do acknowledge authorship.

J. PROUDMAN.

The University, Liverpool,
Feb. 3.

Tanning Materials of the British Empire.

By Prof. JOHN READ.

THERE is much truth in the old saying that there is nothing like leather; and one rejoices that the tanner continues to thrive in an age which has produced substitutes for so many of the common commodities and witnessed the decline and extinction of so many of the ancient crafts. The exceptional calls which were made upon the leather industry during the War led to an enormous demand for tanning materials, but even under the more settled conditions of the last few years the consumption has shown a steady increase. The total value of such materials used in Great Britain in 1928 was £2,413,000, of which more than half was imported from foreign countries; this position cannot be considered satisfactory when the supplies available within the British Empire are reviewed.

The examination of tanning materials has taken an important place among the many valuable series of investigations which have been conducted at the Imperial Institute upon natural products from all parts of the Empire. In 1926 an Advisory Committee on Tanning Materials was constituted, and a recent publication[1] prepared by members of the Institute staff, affords a general account of the chief tanning materials of Empire origin, together with a useful bibliography, and statistics and graphs illustrating consumption and prices in Great Britain. The review includes materials which show promise, in addition to those which have already secured recognition; the classification is under the headings of barks, woods, leaves, fruits, tubers, and miscellaneous materials.

The chief tanning materials grown in Great Britain are oak and larch barks; the combined annual production of about 10,000 tons furnishes, however, only about 7 per cent of the total supply of tannin required for domestic industrial purposes. In spite of its slow rate of penetration into the hide and its high cost, oak-bark tannin is used extensively in producing the best grades of heavy leather. The best English oak bark, grown in Hampshire and Sussex, yields 12-14 per cent of tannin, while good European samples contain 10-13 per cent. Tannin extracts are prepared on the Continent and in North America also from oak wood, which contains 5-13 per cent of tannin; moreover, the cups of the acorns of *Quercus Ægilops*, with a content of more than 30 per cent, are imported extensively from Asia Minor and Greece under the name of valonia. Within the Empire, oaks occur notably in India, Burma, and New Guinea, but it is in the last-named country only that the possibility of utilising the bark or wood as a source of tannin appears to offer promise.

In 1928 the two main vegetable tanning materials used in Great Britain were quebracho (extract) and myrobalans, and these were followed closely by wattle (bark and extract) and chestnut (extract). A glance at the sources of these four materials reveals several points of much interest. Quebracho extract is imported exclusively from the Argentine, and the value of this trade has increased from £142,000 in 1913 to £669,000 in 1928. There appears to be no fundamental objection to the replacement of much of this material by Empire tannins. Myrobalans, the astringent fruits of various species of *Terminalia*, are produced extensively in India. The combined value of the fruits and extract used in Great Britain in 1928 was £381,000, and shipments of almost equal value were made from India to the United States. The pyrogallol tannin of myrobalans has a low rate of penetration and produces a spongy leather; it has consequently been blended with quebracho and other tannins with greater astringency and penetrative power. "Experiments conducted with Empire tanning materials during the War, when there was a shortage of foreign supplies, established the value of the mixed tannage of myrobalans and wattle bark. The astringent, readily penetrating wattle liquors are mellowed by the addition of myrobalans which, through natural fermentation, provide the necessary degree of acidity, and render the leather brighter in colour while diminishing its tendency to become red on exposure to light."

Wattle bark is one of the most abundant and widely used tanning materials of the Empire, and its increasing popularity has led to a careful consideration by the Imperial Institute Advisory Committee of its actual and potential sources of supply. In Australia, the native home of the wattles, there are more than four hundred indigenous species, of which the most important for commercial purposes are *Acacia pycnantha* (the 'golden wattle' of South Australia) and *A. mollissima* (the 'black wattle', a variety of *A. decurrens*). The best commercial specimens of golden wattle bark ('Adelaide bark') contain about 38 per cent of tannin, but in some instances the air-dried material yields as much as 50 per cent, so that *A. pycnantha* provides one of the richest known sources of tannin. Black wattle bark sold in the Sydney market gives an average tannin value of about 30 per cent, unless it has been mixed with the inferior bark of the silver wattle (*A. dealbata*).

At the beginning of the century, Australia enjoyed a thriving export trade in wattle bark, but in 1926–27 the total exports of tan barks (consisting largely of mallet bark from *Eucalyptus occidentalis*) amounted only to £4010. Moreover, in the same year the excess of imports over exports of tan barks reached £23,674. Australia, by virtue of its profusion of wattles, *Callitris* 'pines', eucalypts, and mangroves, possesses unrivalled natural sources of astringents; and yet the paradoxical position has arisen that the Australian leather industry is dependent upon imported tanning materials produced from Australian species of *Acacia* which have been cultivated in South Africa. The decline in the Australian industry is due to a combination of factors, such as wages, labour supply, depletion of natural forests, and lack of market for the wood.

[1] "Tanning Materials of the British Empire." Reprinted from the *Bulletin of the Imperial Institute*. London: Murray, 1929. Price 2*s*.

Of the total financial return from a wattle plantation in Natal, 56 per cent was derived from the sale of bark, 33 per cent from mine props, and 11 per cent from fuel. Natal, which is now one of the main centres of the wattle bark industry, offers a favourable climate for the cultivation of the black wattle, and at present cheap native labour is available for stripping and handling the bark. "According to the secretary of the Wattle and Timber Growers' Association, the present value of the South African wattle industry may be assessed, at a conservative estimate, at £2,000,000 a year, of which more than half is money brought into the country by the export of bark and extract." It is therefore not surprising that the Forest Department of the South African Government has organised a comprehensive scheme of sylvicultural research, dealing with growth measurements, standard yields, optimum age, incidence and extent of insect attacks, fertilisers, etc. Encouraging results have also attended the experimental cultivation of *A. mollissima* and other species in Kenya Colony, Tanganyika, and India.

Chestnut extract is produced mainly from the wood, which when air-dried contains about 8-13 per cent of tannin. The chief producing countries are France, Italy, and the United States, and of the overseas countries of the British Empire only India and Burma offer possibilities for the exploitation of species of chestnut as sources of tannin. Researches carried out at the Forest Research Institute at Dehra Dun have indicated that trees from Burma yield a richer extract than the European trees, but it is doubtful whether the product could be marketed economically under the prevailing conditions.

In these remarks it has been possible to comment only upon a few of the many facts, figures, and investigations finding mention in an unusually interesting publication, which, we are informed, has already been published on the continent in the form of a German translation.

Research in Freshwater Biology and the Functions of a Freshwater Biological Station.

By Prof. F. E. FRITSCH.

FRESHWATERS are put to many different uses. Primarily they are the source of domestic water-supplies, including the huge amount of water required for sanitary purposes. Fresh water is, further, employed in enormous quantities in most, if not all, manufacturing processes. Flowing water is increasingly used as a source of power, while many British waterways serve as a means of communication. An appreciable section of the population, moreover, find relaxation in freshwater fisheries, while many a lake or stream is the centre-point of a beauty spot.

At the same time streams (and sometimes other kinds of waters) serve as the natural recipients of sewage, only too often incompletely purified, and of the waste effluents from a great diversity of chemical works and factories. During the course of the nineteenth century the quick growth of urban populations and the rapid industrial development combined, as a consequence, to bring about a very serious state of pollution in many British rivers, with the result that fish-life was appreciably diminished, and certain kinds, like salmon and trout, disappeared altogether from the more strongly polluted waters. This led to the appointment of a series of Rivers Pollution Commissions, which sat from 1865 onwards, and the reports of which are classical pieces of work which gave to Great Britain a lead of thirty to forty years in water-investigation. Yet, since then, and particularly on the experimental side, we have been far outdistanced by other countries. In the present century, and especially since the War, however, public opinion has again become alive to the evils attendant upon wholesale water-pollution, and various committees have been set up to deal with the matter. Among these, special mention may be made of the Standing Committee on Rivers Pollution appointed by the Ministry of Agriculture and Fisheries in 1921, and the Water Pollution Research Board established in 1927.

The three non-technical reports published by the former Committee (1924–26) contain abundant references both to the lack of scientific knowledge on the organic life of stream and lake and to the need for its acquisition. In the second report (p. 19) it is emphasised as essential that "those responsible for the work of river regeneration should have at their disposal the fullest scientific information bearing on the subject", whilst on p. 24 the same report continues: "At bottom, the problem is doubtless a question of the balance between all the different forms of animal and vegetable life under the particular environmental conditions which prevail", and (p. 12 of the third report) "it is upon the abundance and well-being of these small organisms that the fish-life ultimately depends".

It is, however, not merely in relation to pollution and fisheries that a complete knowledge of the biology of British freshwaters must be of paramount economic importance. It is no less essential from the point of view of domestic water supplies, while ignorance on this subject is no doubt often the unrecognised cause of difficulties or deficiencies in various manufacturing processes in which water plays a considerable rôle. Moreover, a biological treatment of the effluents may well become a practicable matter in certain cases. Nor can it be doubted that fish-breeding would profit from a more adequate knowledge of aquatic biology.

What, then, is the state of our knowledge as regards the biology of freshwaters in general and of our own in particular? Professional biologists and amateur naturalists have done much to acquaint us with the multifarious aquatic fauna and flora, but there are immense gaps in our knowledge. Collecting has been carried out mostly during the warmer period of the year, and few data are available as regards

the fauna and flora during the winter months. Again, the organisms that thrive in the deeper water of rivers and lakes, and especially those that inhabit the stream-bed or the lake-bottom, are, as a result of their relative inaccessibility, very imperfectly known. Our ignorance in this respect is much greater on the botanical than on the zoological side. A recently published account of the attached algal communities of certain British streams includes the description of a new genus and several new species, and analogous investigations in other quarters would probably afford a like result. We are thus at the present time quite inadequately familiar with the organisms that occur in freshwaters, yet whose individual presence or absence may be an index of the purity of the water and the cause of important biological changes. Our knowledge of the life-histories, except in a very few forms, is incomplete, and in only too many cases nil.

Moreover, although at present only clearly demonstrated for small ponds and for the macroplankton communities of larger waters, it is apparent that the microscopic fauna and flora exhibit a very definite annual periodicity and one, too, that varies appreciably in successive years. Such variations in the amount and time of occurrence of the diverse organisms are certainly an expression of corresponding variations in the environment, and by correlating the two, a number of important hints as to the causes underlying the appearance and extent of development of the various denizens of a piece of water are to be obtained.

Conclusions of this kind, however, require to be supported by experiment and by a far more comprehensive chemical and physical analysis of the environment than has hitherto been undertaken. Such work would lead to results of fundamental value, not only from the purely academic point of view, but also because it would provide means of controlling to some extent the nature and degree of development of the organic life in freshwaters.

Again, we possess at present but very fragmentary ideas as to the interrelationships of the diverse animal and plant communities in lake and stream. Although data may be available as to the direct food of certain fish, the nature of the nutriment upon which their prey in its turn relies for sustenance is almost always unknown. Birge and Juday, working on the lakes of Wisconsin, have shown the great importance of the nannoplankton which furnishes a large proportion of the available organic food. Of the nature and extent of the nannoplankton in other waters, however, practically nothing is known. Nor are the interrelationships of the organic communities of freshwaters merely a question of food-relations.

The diverse problems just indicated are not by any means the only ones awaiting solution in the realm of aquatic biology, but have been selected because they are perhaps the most obvious. They are of a similar nature in many kinds of water, and a long stride will have been taken towards their solution by the selection of a typical area of freshwater for intensive investigation over a period of years. For this purpose a properly equipped laboratory, with a permanent staff of scientific workers, needs to be established in the immediate vicinity of one or more suitable water-surfaces. The problems are not such as can be solved by occasional visits followed by work in a university laboratory, but in practically all cases require daily observations and records made on the spot. Even a water sample does not remain the same if carried some distance before analysis.

The staff of such a laboratory would make it their business, not only to become acquainted with the fauna and flora all the year round, but also would undertake regular chemical and physical investigation of the water in order to correlate changes in the one with changes in the other. Plentiful experimental work would be necessary in order to substantiate the conclusions thus arrived at. Moreover, a detailed study of the life-history of many of the organisms present would have to be undertaken, since their whereabouts and state of existence during the 'absent' period would in many cases, no doubt, prove to have a direct bearing on their time of maximum abundance. An important function of such a station would further be to initiate new methods of limnological investigation and to test the efficacy of those in current use.

Freshwater biological laboratories of this kind have long been in existence on the continent, among the more important being those of Plön in Germany, Lunz in Austria, and Aneboda in Sweden, all supported by public funds and growing in importance year by year. While the work at such stations should primarily be of the nature of fundamental pure research, it is highly desirable that those concerned with applied problems should already, at an early stage, occupy working places in the laboratory. While they may obtain considerable help from the permanent scientific staff, the latter would profit greatly from contact with the economic problems that have to be solved.

It is not considered necessary to stress the scientific importance of such an institution, which was made sufficiently clear in the widely attended joint discussion between sections D and K at the Glasgow (1928) meeting of the British Association on "The Biological Investigation of British Freshwaters". An additional point to be made, however, is that a station of this kind would soon furnish a quota of limnological workers who could be drawn upon for the solution of applied problems, whilst it would stimulate work in other parts of the Empire and provide instruction in modes of attack.

It is with the prime purpose of securing the establishment of such a laboratory that the Freshwater Biological Association of the British Empire (inaugurated at a meeting held in the rooms of the Linnean Society of London in June of last year) has been founded. In order to arouse public interest and to initiate the raising of the necessary funds, the Council of the Association has invited all interested parties to a meeting to be held at 2.30 P.M. on Feb. 21 next, at Fishmongers' Hall, by kind permission of the Court of the Fishmongers' Company. The chair will be taken by the Right Hon. Lord Rothschild, president of the Association.

Obituary.

MAJOR P. A. MACMAHON, F.R.S.

ON Christmas Day of last year, Major Percy Alexander MacMahon died at Bournemouth. By his death, the science of pure mathematics has lost a distinguished devotee with a striking individuality. Not that MacMahon was solely a scientific investigator. He had been a soldier; he retained the title of his military rank to the end of his days. He had been engaged in teaching for not a few years; his powers of exposition were marked by a clear directness that could be envied. He had been a Civil Servant; for fourteen years, until his retirement in 1920 under the age-limit, he was Deputy Warden of the Standards of the Board of Trade. But throughout all the stages in his varied avocations, MacMahon achieved and maintained a high reputation as a pure mathematician.

The outward facts of MacMahon's life may be recorded briefly. Born at Malta on Sept. 26, 1854, he was the second son of Brigadier-General P. W. MacMahon. His school was Cheltenham: on leaving school, he went to the Royal Military Academy at Woolwich and entered the Royal Artillery in 1872. He was professionally connected with that arm for many years until he was of standing for promotion to colonelcy; but he abstained from qualifying for promotion, and he retired with the rank of major. Some early years of military duty were spent in India. On his return to England he was drafted into the educational side of military training. He was appointed an instructor in mathematics at Woolwich in 1882: there, he was a colleague of his former teacher, Prof. A. G. (afterwards Sir George) Greenhill, for whose powers he ever retained the highest respect. Later, in 1890, he was appointed professor of physics in the Ordnance College; and from 1904 to 1920 he was attached to the Board of Trade, in the office already mentioned.

Concurrently with all these successive professional occupations, MacMahon was diligently engaged in research. In no long time he had established a mathematical reputation by his investigations, published in the *Quarterly Journal of Mathematics*, the *Proceedings of the London Mathematical Society*, the *American Journal of Mathematics*, and the *Proceedings of the Royal Society*. Soon, a gradually growing share in the official activities of learned societies was assigned to him. He was elected a fellow of the Royal Society in 1890: was president of the London Mathematical Society in 1894–96: was president of the Royal Astronomical Society in 1917: and for many years, either at intervals, or for long continuous periods, he was a member of the respective councils of those bodies. He also acted as a General Secretary of the British Association for twelve years: in 1914 he was appointed a Trustee: while in 1901, at the meeting in Glasgow, he was president of Section A (Mathematical and Physical Science) of that body, delivering an interesting address upon the general aspects of the subjects of his own mathematical preference.

The value of MacMahon's original work was widely recognised by the conferment of honours, such as academic and scientific corporations alone can worthily confer. Unconnected with any university by training, he received a number of honorary degrees; he was made doctor of science by Dublin in 1897 and by Cambridge in 1904, and doctor of laws by Aberdeen and by St. Andrews in 1911. It is no secret that he was all but appointed Savilian professor of geometry in the University of Oxford in succession to Sylvester, on the latter's death in 1897. In his later years, until his health broke down in 1928, when he removed to the south coast of England, he and his wife settled in Cambridge. After his honorary doctorate, and by express invitation, he had joined St. John's College, Cambridge, a college including in its foundation many personal friends such as the present Master (Sir Robert Scott), Sir Joseph Larmor, and Prof. H. F. Baker, among the mathematicians.

Nor were scientific honours less profuse than those of an academic quality. MacMahon was elected an honorary member of the Royal Irish Academy and of the Cambridge Philosophical Society. The Royal Society appointed him its representative as a governor and fellow of Winchester; and awarded him a Royal Medal in 1900 and the Sylvester Medal in 1919. The London Mathematical Society awarded him the De Morgan Medal in 1923.

Thus MacMahon's military career had gradually merged into avocations connected specially with pure science; and the worth of his scientific life had met with ample recognition. But the real crown of his scientific life is constituted by the additions to knowledge which he achieved in the course of his mathematical investigations.

MacMahon's contributions to mathematical science are contained in many separate memoirs, more than one hundred in number, and in one treatise on the grand scale, his "Combinatory Analysis" in two volumes, published (1915, 1916) by the Cambridge University Press. The development of his genius, when once he had settled into his main region of original research (and he settled early), was swift and clear, as exhibited by the sequence of topics in his memoirs regarded chronologically; and that development was maintained with a continuity which was remarkable and persistent. His earliest papers were rather scattered in their subjects: he dealt with isolated topics, with some properties of special curves or the integrations of some differential equations connected with elliptic functions. But very soon his true line had been found: thereafter, progress was steady and unhalting.

His real beginning was made not later than 1883 by a simple discovery which opened up a new field of investigation and completely transformed one range of the theory of invariantive forms, created and amplified by Cayley, Sylvester, and Hermite. In that theory it had long been known that any seminvariant—that is, an invariant or the leading coefficient of a covariant—of a binary quantic of quite general rank satisfies a central linear partial differential equation of the first order, which depends

solely upon the parametric coefficients of the quantic. It was also a matter of established knowledge that, subject to one proviso, a symmetric function of the roots of an algebraic equation of quite general degree satisfies another linear partial differential equation of the first order, which likewise depends solely upon the parametric coefficients in the equation. The limiting proviso is that the partition of the symmetric function must be non-unitary: that is to say, if the symmetric function of the roots $\alpha, \beta, \gamma, \ldots$ of the equation be denoted by the expression $\Sigma\alpha^p\beta^q\gamma^r \ldots$, no unit integer shall occur in the partition $p, q, r, \ldots$ of the number $p+q+r+\ldots$ which is the weight of the function.

MacMahon's discovery (hailed as 'very remarkable' by Cayley) was that, by mere arithmetical changes connecting the coefficients of the quantic $(a_0, a_1, a_2, \ldots)(x, 1)^n$ with the coefficients of the equation $c_0x^n + c_1x^{n-1} + c_2x^{n-2} + \ldots = 0$, the critical differential equation satisfied by the seminvariants of the quantic becomes identical with the critical differential equation satisfied by the non-unitary-partition symmetric functions of the roots of the equation. These arithmetical changes, by which the coalescence is effected, are

$$a_0 = c_0,\ a_1 = 1!c_1,\ a_2 = 2!c_2,\ a_3 = 3!c_3, \ldots$$

The property, thus discovered, entails the consequence that seminvariants of the quantic and non-unitary-partition symmetric functions of the roots of the equation are formally equivalent, if the foregoing relations hold between the two sets of coefficients. For example,

$$a_0^2\Sigma\alpha^2 = a_1^2 - a_0a_2,\ 2a_0^3\Sigma\alpha^3 = -(a_0^2a_3 - 3a_0a_1a_2 + 2a_1^3),$$

$$12a_0^2\Sigma\alpha^2\beta^2 = a_0a_4 - 4a_1a_3 + 3a_2^2.$$

Thus seminvariants of a quantic can be treated as non-unitary-partition symmetric functions of an associated ordinary algebraic equation. This range of invariantive forms can therefore be constructed from the results of the pure algebra of symmetric functions, the weight of the form being the same as the weight of the function. In turn, by its dependence on the non-unitary-partitions of the weights, this pure algebra invokes the theory of the partitions of numbers. MacMahon's initial discovery thus made a link between the theory of invariants and one branch of the theory of numbers. As invariants can arise through continuous variation of the magnitudes which occur, while partitions are necessarily concerned with discrete magnitudes, all the cognate work established another connexion between the calculus of continuous quantity and the calculus of discontinuous quantity.

The ensuing researches had one important, almost an immediate, result. Progress in the theory of covariantive forms had, to some extent, been barred through lack of a complete mastery over the syzygies, that is, the homogeneous relations among the seminvariants. But owing to this new correspondence between seminvariants (or perpetuants, as Sylvester styled them) and the non-unitary-partition symmetric functions of the roots of an equation, the syzygies in question were transferred to the region of the selected symmetric functions. The last can be enumerated by means of the partitions; the relations, which connect them, are established by algebra of a simple character initiated by Newton: and the calculations thus became matters of pure arithmetic and algebra.

The way thus was indicated for a new algebraical proof of one theorem of fundamental importance—the finiteness in number of the aggregate of the asyzygetic concomitants of a binary quantic; it had previously been known only by Gordan's proof, which used the methods of umbral representation. By Cayley and MacMahon, among others, especially in relation to syzygies, to generating forms, and to ground-forms, the algebraic work was developed. By MacMahon himself, utilising earlier researches of Sylvester and others on the partition of numbers (and, as a happy incident, securing for publication some forgotten unedited lectures of Sylvester on the subject) a full development of partitions in general, with many ramifications and amplifications, was revealed. The work was (what, in another connexion, Sylvester had called) a new world of analysis.

Accounts of the work, while still it was in progress, will be found (though with much self-effacement) in MacMahon's presidential address to the London Mathematical Society (*Proc. Lond. Math. Soc.*, vol. 28, pp. 5-32; 1897) in 1896, and in his address as president of Section A at the Glasgow meeting of the British Association in 1901 ("British Association Report", pp. 519-528; 1901). Memoir succeeded memoir in his consecutive development of the theory over a number of years. He dealt with matters apparently so diverse as symmetric functions; differential operations and their comparative effects: partitions of numbers, unipartite and multipartite, their separations and their compositions: permutations, in a multitude of associations: Euler's Latin squares; magic squares, ancient and modern: diophantine equations and inequalities: enumerating (or generating) functions, in their persistent emergence throughout the theory. Finally, he produced a systematic account of all this work, including cognate investigations of other writers, in the treatise "Combinatory Analysis", cited earlier. It is a fitting and an abiding monument to his genius.

Nor did MacMahon disdain the lighter issues of his work. It admitted of illustrations and applications that can appeal (though, as the world estimates pure mathematics, too seldom do appeal) to those who are unversed in mathematical phraseology and mathematical conclusions. Thus he delivered an almost untechnical lecture on "Magic Squares and other Problems on a Chess-Board" as a Friday evening discourse at the Royal Institution on Feb. 14, 1902. At the same place, on the afternoons of Jan. 30 and Feb. 7, 1907, he lectured on "Standards of Weights and Measures". His interest extended to special problems such as finding the totality of ways of seating a number of married couples at a round-table dinner-party, so that each lady sits between two gentlemen and no lady is next her husband. He found relaxation and amusement in using the ideas of combinations and permutations for the construction of ingenious

(yet not useless) pastimes. Thus, to select one instance, full sets of pieces of cardboard are required: all the pieces of a single set are to be of the same shape (usually triangular, or square, or hexagonal) and of the same size : they are to be coloured, each, for example, with three out of four colours, while no two are to be coloured in exactly the same way. By the adoption of definite rules for combining the pieces of a set, a large number of different forms can be obtained, each such form being a geometrical pattern. Each pattern can be repeated so as to provide a general symmetric design. The designs can be utilised in a variety of ways : for humble wall-paper, for mosaics and woven fabrics, for the refined ornament of architecture. In a small volume entitled "New Mathematical Pastimes", published in 1921 by the Cambridge University Press, he gave an account of these recreations, at once light and serious : the contents are entirely his own creation.

MacMahon's investigations extended over nearly half a century. Many in number, diverse in range, they constitute a fine contribution to his science, and they assure him an honourable place among the prominent pure mathematicians of his generation.

A. R. F.

Prof. T. Brailsford Robertson.

News has been received of the death on Jan. 25, from septic pneumonia, of Prof. Brailsford Robertson, of the University of Adelaide. His premature death, at the comparatively early age of forty-five years, removes one of the most active and valuable workers from biochemical research, and is a very serious loss to the recently instituted movement for the more rapid application of biological knowledge to the development of animal husbandry in Australia.

Thorburn Brailsford Robertson was educated at the University of Adelaide. In 1904, attracted by the work of the late Jacques Loeb at the University of California, he went there as a research student in biology and for several years worked in close collaboration with Loeb, and eventually succeeded him as professor of biochemistry and pharmacology at Columbia University in 1916. In 1918 he was called to the chair of biochemistry at the University of Toronto in succession to Prof. A. B. MacCallum, and in 1920 he returned to Adelaide as professor of biochemistry and general physiology in succession to his father-in-law, the late Sir Edward Charles Stirling.

From 1920 until the time of his death, Prof. Brailford Robertson occupied a prominent position in Australian biological science, both in pure research and in the application of the results of research to industrial problems. He was one of the founders of the *Australian Journal of Experimental Biology and Medical Science*. When the Commonwealth Council for Scientific and Industrial Research was instituted a few years ago, he was invited to become the chief officer in charge of investigations on the nutrition of animals. To enable him to devote the major part of his time to this work, he was relieved of teaching at the University, though he continued to be a member of the Senate, so that his experience might be available in developing the school of biochemistry and physiology at the University.

Prof. Robertson was an assiduous worker and a prolific writer. He did most important work on the physical chemistry of the proteins, and later conducted long and laborious research on problems of growth and senescence. Among the problems of general physiology to which he made valuable contributions may be mentioned allelocatalysis as a factor in the multiplication of infusoria, the permeability of cells and the underlying physico-chemical principles involved in cell division. In addition to numerous papers in scientific journals, he published "The Principles of Biochemistry" and other two works, namely, "The Physical Chemistry of the Proteins" and "The Chemical Basis of Growth and Senescence", in both of which he incorporated the results of his own original work on these subjects.

Prof. Robertson had a stimulating personality, and, as a lecturer, had the gift of imparting his new enthusiasm to his audience. His death will be deeply regretted in scientific circles, especially in North America and Australia, in both of which continents he exercised a great influence in the development of biochemistry, both as a science and in its application to practical problems. The loss of his profound scientific knowledge and great experience in organisation will be a very serious blow to the work of the Commonwealth Council for Scientific and Industrial Research.

J. B. O.

Mr. F. P. Ramsey.

The death on Jan. 19 of Frank Plumpton Ramsey at the early age of twenty-six has cut short a life which bore exceptional promise of eminence in mathematics and philosophy. The elder son of Arthur Stanley Ramsey, now President of Magdalene College, and the author of well-known treatises upon subjects in applied mathematics, Frank Ramsey was born in 1903 and passed his boyhood in Cambridge. From King's College Choir School he became first a scholar of Winchester, and then a scholar of Trinity College, Cambridge : in 1923 he graduated in the first class of the Mathematical Tripos, with distinction, and in 1924 was elected to the Allen (University) Scholarship. At the time of his death he held a University lectureship in the Faculty of Mathematics, and was a fellow and director of studies at King's College, Cambridge.

It could not be expected that Ramsey's published work would fill a large number of pages ; yet there is enough to prove the distinction of his mind and powers. The London Mathematical Society has printed two weighty papers, "The Foundations of Mathematics" (1926) and "On a Problem of Formal Logic" (1929). The former, written after Ramsey had become acquainted with the work of Wittgenstein, is probably his most important original production. In it he aims at presenting the general method of Whitehead and Russell in a

form free from the objections raised by German critics: there can be little doubt that Ramsey would have returned to this subject and further developed it. He has written on 'universals' in *Mind* (Oct. 1925), and on mathematical logic in the "Encyclopædia Britannica" and elsewhere. Two papers in the *Economic Journal*, on the mathematics of taxation (March 1927) and of saving (December 1928) must be mentioned, on account of the high praise bestowed upon them by economists competent to judge.

This scanty list reveals the bent of Ramsey's mind. As a student he proved himself a mathematician of exceptional gifts, but his interest and strength lay in the application of mathematics to problems of philosophy or economics. His main interest was in the very difficult boundary region between mathematics and logic: in this he was already recognised as an authority. For a truer appreciation of him as a man we must turn to his contemporaries, his friends and colleagues. To them, Frank Ramsey seemed to tower over his fellows intellectually even as he did physically—for he stood 6 ft. 3 in. or thereabout and was of unusually sturdy build. What Ramsey might have achieved, how grave the loss to learning in his untimely death, they cannot tell; but the memory of a friend who combined unrivalled powers of mind with an unassuming simplicity of manner and character will remain.

Ramsey married in 1925, Miss Lettice Cautley Baker, and leaves two daughters. At the end of November he was attacked by influenza, the ill-effects of which persisted. At length an operation was judged to be inevitable, and after it he died.

WE regret to announce the following deaths:

Prof. Charles Julin, member of the Belgian Royal Academy of Sciences and formerly professor of comparative anatomy in the University of Liège, known for his work on the morphology and embryology of the Tunicates, on Feb. 5, aged seventy-three years.

Dr. E. D. Roe, Jr., director of the observatory and for twenty-nine years professor of mathematics at Syracuse University, known for his interest in pure mathematics, the testing of objectives and double stars, on Dec. 11, aged seventy years.

Prof. Eduard Study, emeritus professor of mathematics in the University of Bonn, author of works on the geometry of dynamics, on ternary forms, spherical trigonometry, orthogonal substitution and elliptic functions, on Jan. 6, aged sixty-seven years.

Prof. A. V. Vasiliev, of the Universities of Kazan and Leningrad, who was distinguished for his work on the theory of numbers and mathematical philosophy and was instrumental in establishing the Lobachevski prizes for works on non-Euclidean geometry and mechanics, on Oct. 6, aged seventy-six years.

News and Views.

RATIONALISATION, especially in reference to the chemical industry, was the subject of a paper by J. Davidson Pratt, general manager of the Association of British Chemical Manufacturers, read at the University of Bristol on Feb. 6. The general principle that exact knowledge should be the basis of industrial policy was most clearly stated: and of course the principle is in practice recognised more generally in the chemical than in other industries. Imperial Chemical Industries and the German I. G. are well known. Chemistry involves so obviously the problem of research and co-ordination of results that the tendency to large scale and long range thinking in the industries dependant upon a knowledge of chemistry can scarcely be resisted. Mr. Pratt was in fact preaching to the converted. But the conversion, as he pointed out, has not gone far enough. Besides the important issues with which he dealt there are others. National 'rationalisation' on the basis of amalgamation or association of firms gives the group so united a great *political* influence, which in practice has been used for the introduction of protective tariffs and the maintenance of high prices within the tariff-wall. It is quite useless to say that the consumer should not suffer. He will, unless policy prevents it, and the policy of a national amalgamation in any trade is never in favour of the consumer at home, unless competition is feared from abroad. But even international agreements may be aimed only at keeping prices up.

IN Great Britain, however, we have still a long way to go towards standardisation and amalgamation in most industries before any danger to the consumer need be feared. For example, the coal industry seems still to be thought of, even by its reformers, as a separable industrial unit. But would not true rationalisation be based upon the *uses* of coal, not the mere getting of coal? Chemistry has scarcely been used by those who have controlled the policy of coal-getting. They have provided productive industry and the private consumer with primitive lumps of a natural product and given no attention to research either for power supply or for by-products. If one may venture upon political issues, neither the Samuel Report nor the present Government's Coal Bill has envisaged the chemical connexions of coal. The whole industry is pre-scientific. The chemists have still a large field to enter, outside what are called the chemical industries. The danger, indicated but not emphasised by Mr. Pratt, is that the financier and industrialist will not go far enough in the application of scientific knowledge and the promotion of research. It is very tempting to 'rationalisers' to be satisfied with a collection of meaningless statistics as to existing processes or methods.

NEVER before in the history of the world have greater or more momentous issues presented themselves in the political sphere than those which now confront us. Even the greatest of all at any time, that of peace or war, though not now a direct or immediate issue, can never be far away but lurks as a sinister phantom in the background. There is thus the greater need on the part of the electorate in any democracy for intelligent apprehension of the many difficult and intricate political problems which call so urgently for solution—and the political here neces-

sarily includes the economic. The trouble hitherto has been that everyone feels himself competent to discuss and even to decide weighty matters in this field without knowledge or trained habits of thought. Ignorance, shallowness, prejudice, and, above all, garrulity, reign supreme. No wonder the scientific mind turns from politics in disgust, and this is a thousand pities; for, as we have frequently urged, there is plenty of scope for the scientific habit of close, concentrated, creative thought.

AMID the vast mass of political writing and speaking which deafens and confounds the modern ear, one has to proceed with discriminating caution. It will frequently be necessary to rule out and refuse to take too seriously the political diatribes of the daily Press, in view of the conditions under which these are produced. The monthly reviews are sometimes helpful, but despite the profusion of our periodical literature, it yet seemed that there remained room for a monthly or quarterly review devoted solely to the political field, forming a platform for serious and well-informed students of politics. So far as one can tell from the first number of the new review, *The Political Quarterly*, published by Messrs. Macmillan and Co., Ltd. (price 3*s*. 6*d*.), and controlled by a very competent editorial board, it seems reasonable to hope that we have here a guide, counsellor, and perchance a friend, amid the thorny mazes of politics. The first number is well balanced and contains several concisely written and authoritative articles, book reviews, and surveys of current affairs. Alfred Zimmern's "Democracy and the Expert" should prove of considerable interest to men of science, who will also appreciate the attempts made to interpret the large amount of real experimental research and its results now undertaken in the social and political sphere. The new review takes a progressive point of view and intends to act as a medium of constructive thought.

SUBSTANTIAL progress is now being being made with the grid of 132,000-volt overhead wires which will ultimately connect together all the large and efficient electric stations in Great Britain. Up to the end of last year, about sixty miles of the system had been completed, but before the end of this year there will be nearly a thousand miles of the system in operation. The principal main line so far constructed extends from Greenock through Glasgow to Bonnybridge. It includes high level crossings over the Cart and the Clyde and the extension to Dundee crosses the Forth and gives a clearance of 100 feet above high-water level. The problem of supplying consumers in small villages and farms has not yet been satisfactorily solved. The 33,000-volt lines already in operation in several districts have given little trouble even during the exceptionally stormy weather that has occurred recently. Straw blown from stacks has occasionally short-circuited the insulators, and the sea salt deposited on the line insulators near the coast has in a few instances caused them to flash over. In Ayrshire the lines have been struck directly by lightning on several occasions, but beyond opening the automatic switches little difficulty has been caused. It is important that children should be taught in schools the nature of conductors and insulators of electricity. Possible dangers arising from high pressure conductors should also be pointed out. In America there has been at least one fatality due to the wire of a kite flown by a boy nine years old coming into contact with a high pressure overhead wire. A damp string in similar circumstances might conceivably be dangerous.

IN a paper read to the North-East Coast Institution of Engineers and Shipbuilders on Feb. 7, Mr. S. Cook discussed the value of high pressure steam for marine work. The significance of the term high pressure steam has changed with each succeeding generation of marine engineers. At one time, even 15 lb. or 20 lb. per sq. in. was considered high pressure. In early days, some of the foremost engineers declared against the use of high pressures, the theory not being understood. Then, too, faulty construction often led to trouble. To-day, 200 lb. per sq. in. may be regarded as a standard pressure at sea, though some ships are using steam at 300 lb. or 400 lb. per sq. in. pressure, while the Clyde steamer *King George V*. has run successfully for three seasons with a boiler pressure of 550 lb. per sq. in. and steam superheated to 750° F.

INCREASES in thermal efficiency can be obtained by raising the pressure or temperature, and by means of tables Mr. Cook set out the effect on thermal efficiency due to (1) superheat only, (2) increase of pressure only, and (3) increase of pressure and temperature. From the tables it was shown "that an increase of temperature at 200 lb. per sq. in. by superheating to 750° F. increases the efficiency from 31·9 per cent for the saturated condition to 34·0 per cent for the higher initial temperature. Whereas if this increase of temperature is accompanied by an increase of pressure to 1000 lb. per sq. in. the efficiency is increased from 31·9 per cent to 39·8 per cent, a total improvement of 25 per cent, the greater part of which is due to increased pressure." In touching upon the type of boiler, the quality of the feed water, the design of condensers, and other practical matters, Mr. Cook made the interesting statement that, in spite of the high pressure in the *King George V*., in three and a half years it had not been found necessary to remake a single main steam pipe joint.

THE issue of the *Journal of the Society of Chemical Industry* for Jan. 24 contains an interesting illustrated article by Sir Robert Hadfield, T. G. Elliott, and R. J. Sargant on recent developments in corrosion and heat-resisting steels. They give a good historical account of the development of stainless chromium steel, in which the work in France from 1876 onwards, the discovery by Brearley in Sheffield in 1912 and after that this steel could be hardened, tempered, and polished for use in making stainless cutlery, and other investigations are reviewed. Sir Robert then points out that his firm is now collaborating with the Fourchamboult Co. in France and the Midvale Steel Co. of Nicetown, Pa., in the development of a series of heat-resisting steels. These are of two types, those which are hardened by quenching and those which are softened. In the former, chromium is practically

the only alloying element, and by varying the amount of carbon the steel may be made to range from a soft material suitable for stamping into dishes and pans to a hard steel suitable for knife blades. The best corrosion resistance is obtained with somewhat higher chromium percentages, namely, 17-18, than the 12·5-14 formerly used. A steel with 17 per cent or more of chromium and 7 per cent or more of nickel is not hardened by quenching and has superior corrosion resistance, although it is more expensive. The article gives many details of the structures, resistance to acids, etc., of these steels, and also of their industrial applications, including furnaces and operations involving high temperatures and pressures.

A PROPOSAL to excavate the Roman city of Verulamium was considered at a meeting of the St. Albans City Council on Feb. 4, when the Parks Committee presented a report which had been made by Dr. R. E. Mortimer Wheeler on behalf of the Society of Antiquaries at the request of the Mayor. The report stressed the importance of Verulamium, first as one of the great tribal capitals of prehistoric Britain, and secondly as one of the great centres of Roman Britain, which grew up as a city of the first rank a century or more before London was even founded. It appears to be the only city in Roman Britain which attained the rank of a *municipium*. Dr. Wheeler suggests that the examination and consolidation of the better preserved stretches of the Roman defences should be given precedence. These defences consist of a magnificent ditch, unequalled in Britain, a level platform or berm, behind this a wall of flint-rubble with bonding courses of brick, and a broad and high bank piled against the inner side of the wall. The wall is at present in some danger from the weather and the disintegrating action of ivy and tree-roots. When the defences have received attention, it is suggested that the plan of the town should be revealed and the principal buildings located. The Council decided to appoint a committee for this work to which the Society of Antiquaries and the St. Albans and Hertfordshire Archæological Society would be invited to appoint representative members.

A PAPER was read on Jan. 27 by Prof. R. A. S. Macalister and Prof. J. K. Charlesworth before the Royal Irish Academy dealing with the archæological finds at Rosses Point, Sligo. The announcement of the discovery of these implements was first made by Mr. J. E. P. Burchell in NATURE of Aug. 20, 1927, p. 260. An energetic discussion followed, during which directly opposing views were expressed, even by archæologists who accepted the human origin of the implements. The geological evidence is almost unanimously opposed to the possibility of palæolithic implements being found in this particular part of Ireland. Profs. Macalister and Charlesworth expressed the opinion that until archæologists can reconcile their own differences, and find some means of squaring their conclusions with those of geologists, there is nothing to be gained for science from these implements.

SIR DOUGLAS MAWSON'S Antarctic expedition has returned to Kerguelen to coal the *Discovery*. It is now too late in the season to allow further exploration within the area of pack-ice. Reports to the *Times* summarise the season's work. The edge of the land has been outlined between long. 44° E. and 66° E., including Enderby, Kemp, and MacRobertson Lands. Farther east as far as 90° E. the position of the continental margin has been indicated by soundings. Much of the new coast line is fringed by ice cliffs. The ice sheet is pierced by many rocky nunataks, and several definite mountain ranges have been charted, of which the principal is Scott Range in Enderby Land. It has about 200 peaks, occasionally rising to 7000 feet, and some of these have been fixed. From the rock collections on the coast, islets, and from the dredge there is every indication that this part of Antarctica is built of ancient crystalline and early sedimentary rocks. Much oceanographical work has been done with the sonic sounder and deep sea water-bottle. This is probably more detailed than any previous expedition has been able to do. High-level meteorological observations show that at 5000 ft. the principal air currents are from the north-west to south-east. The strong gales off Enderby Land are from the east or north of east, and not from the south-east as they are in Adelie Land and elsewhere on the plateau coast. The pack-ice is thus driven to the west or south of west, and the coasts of Enderby and Kemp Lands are kept comparatively clear except for the impediment offered by great rows of bergs, from farther east, stranded in the shallow water of the continental shelf. East of Kemp Land there is much pack, reminiscent of the heavy ice of the Weddell Sea.

A SHOWER of fishes from the sky might be reckoned one of the classic stories of anglers, were it not that abundant evidence exists of this natural phenomenon. Dr. E. W. Gudger, who on two previous occasions has recorded the results of his investigation of falling fish records, returns to the subject in the December *Scientific Monthly*. In all, he has found about seventy-one accounts, more or less well authenticated, of rains of fishes extending from A.D. 300 up to the present time, and in space encircling the whole globe. He adds one or two new records: in May 1900, at Rhode Island, when boys gathered and sold fishes by the pailful, and in May 1928, when hundreds of small fishes were deposited on a newly planted cotton plot at Tarboro, in North Carolina. Of course, the explanation of the fish rain is the same in every case. High winds, particularly whirlwinds, pick up water, fishes and all and carry them inland, and when the velocity of the air and clouds becomes relatively lowered, the fishes fall to earth.

IN view of the serious aspect which the slaughter of whales for commercial purposes has assumed, it is significant that the economic extinction of whales falls to be recorded from a new area. For the second time in history there are no longer sufficient whales along the Californian coast to support a whaling industry (*California Fish and Game*, p. 337; Oct. 1929). In 1865 there were eleven whaling stations on the coast

of California, and a considerable fleet of ships was employed in the industry. Writers often mentioned seeing fifteen whales at one time in one place, and in 1853 it was estimated that fully 30,000 Californian grey whales visited the California coast annually. By 1880 the decline in whaling was noticeable; by 1890 practically no whaling was possible along the coast. Then in 1919, with the gun-harpoon and speedy ships with a hundred-mile radius, commercial whaling again began in Monterey Bay. In the new operations, as was to be expected, only four or five California grey whales were killed, but 781 hump-backs were secured within three years. Now the hump-backs also have been reduced below the economic level. In less than ten years of operation, the Moss Landing whaling station has been dismantled and operations abandoned because of lack of whales. It is a fortunate thing that demand is not sufficient to endanger still more the surviving breeding stock. No laws have been enacted in California to curtail the catch or otherwise to protect whales.

IN his Friday evening discourse on "Diving" delivered at the Royal Institution on Feb. 7, Prof. Leonard Hill showed and described the new submarine escape dress which has recently been tested by the Admiralty. He also showed a new self-contained diving dress with an injector for circulating the air in the helmet through soda lime and worked by the feed from a cylinder of oxygen and air. With this dress the diver is independent of hose pipe, and can detach and fix his life-line containing telephone wires, and proceed with a distance line into a wreck. The danger of oxygen poisoning has to be met by suitable concentration of oxygen in the air supply, and fixed periods of work at various depths. The decompression of divers by the new submersible decompression chamber of Mr. R. H. Davis was dealt with and the use of oxygen for washing nitrogen out of the body, so halving the present times for decompression, was discussed. Speaking of the danger of oxygen poisoning, Prof. Hill suggested that air containing only 10 per cent or even 5 per cent of oxygen should be used for deep work at say 300 ft., the diver enriching the air he breathes with oxygen while climbing up, and then breathing pure oxygen on entering, at 66 ft., the submersible decompression chamber and while being decompressed in that chamber. By such means diving at 300 ft. or even 350 ft. can be made safe.

MR. REIJIRO WAKATSUKI, the chief Japanese delegate to the Naval Conference, spoke to the people of Japan on Feb. 9 by Marconi beam telephony from the Imperial and International Communications Marconi Beam station at Dorchester, his speech being relayed throughout Japan by means of the Japanese Broadcasting Company's stations. The wireless telephony apparatus designed by the Marconi Company was connected to the beam telegraph aerial used for telegraphy with Japan, and reports received indicate that the transmission over the great distance separating the transmitting and receiving stations was very satisfactory. The incident is noteworthy because it was only six years ago that Marconi first transmitted intelligible speech to Australia, and the evolution of the system of combined telegraphy and telephony on the beam aerials marks the progress which has been made in transmission over long transcontinental distances.

IT is announced by the Hague correspondent of the *Times* that on Feb. 10, M. Reimer, Minister for Dykes and Waterways in Holland, opened the first pumping stations for the draining of the Wieringen Polder, the first of the polders to be completed in the scheme for the reclamation of the Zuider Zee. One station is at Den Oever at the north, and the other at Medemblyk at the south of the polder, and about eight months will be required to free the polder of water. The project for the enclosure of the Zuider Zee was described in an article in NATURE of Sept. 21, 1929, by Dr. Brysson Cunningham. The Wieringen or North-west Polder, with an area of about 50,000 acres, is the smallest of the four polders contemplated. When the whole of the reclamation work is completed, it is estimated that more than half a million acres, or about 10 per cent of its present area of arable land, will be added to Holland. The enclosed area will not, of course, be immediately available; it is considered that six or seven years must elapse before it reaches its full cultivable value.

VARIOUS agencies tend to an improvement of the condition of urban atmospheres. None can be more welcome than the action of the Royal Institution of British Architects in issuing a report on smoke abatement (price 1*s*.). The widespread damage to buildings has convinced the architects of the need, and they have much—sometimes all—of the responsibility for choosing the appliances for consuming fuel in domestic and other buildings. There can be little doubt that if architects as a body strive to prevent the introduction of smoky appliances into buildings, considerable amelioration should in time follow. The report gives an account of the law as to atmospheric pollution. Technical information as to the effects of smoke and sulphurous impurities on buildings is given, and recommendation as to the choice of fuel and heating systems. Little exception can be taken to the technical contents, but here and there appear signs that no one on the Committee had first-hand knowledge of fuels. Still, the report is for architects, not fuel experts.

THE fourth annual report for 1929 of the Pharmacological Laboratories of the Pharmaceutical Society of Great Britain indicates that the time of the staff was divided between research work and the examination of samples submitted by manufacturers. Some of the problems investigated were suggested by the revision of the "British Pharmacopœia". The director, Dr. Burn, working with Prof. Bijlsma and Dr. Gaddum, has found that the oxytoxic value of a pituitary (posterior lobe) extract does not necessarily indicate its pressor or antidiuretic activity: each property must be assayed separately. The pressor principle has antidiuretic activity and also inhibits the fall of blood-sugar produced by insulin. Examination of samples of strophanthin by Mr. Wokes

indicated that the average activity was only 60 ± 15 per cent of the international standard ouabain : the strength of commercial tinctures of strophanthus was found by Dr. Burn to be about equal to a 0·42 per cent solution of the standard ouabain, the majority lying between 0·31 and 0·53 per cent. Dr. Barba-Gosè has investigated the toxicity of samples of tetraiodophenolphthalein, the determinations being carried out by intravenous injection into the tail vein of mice: the criterion used was the death of half the animals within three days. The toxicity was found to vary from 0·27 mgm. to 0·37 mgm. per gm. mouse. Dr. Coward, who is in charge of the nutrition department, has carried out a number of investigations on different vitamins. With Key and Morgan she has obtained evidence of a new growth factor for the rat, which is found in certain samples of casein, in fresh milk, lettuce, fresh and dried grass, beef, liver and wheat embryo, but is absent from dried yeast and butter. Its presence is essential in the synthetic diets used for assay of vitamins A or B. Dr. Coward has also found that cod-liver oil contains from 50 to 150 units of vitamin D per gm., butter 0·8-1·0 unit per gm., milk 0·2 unit per gm. as a maximum, and irradiated milk from 0·1 to 2·0 units per gm. The staff of the Laboratory, together with attached workers, published seventeen papers during the year.

AMONG the contributions contained within Vol. 11 of *Nauka Polska*, 1929 (*Science and Letters in Poland*, an annual publication edited by Prof. S. Michalski) mention may be made of Prof. Paul Rybicki's communication on "Learning in Relation to Social Life; Some Borderline Problems of Sociology and the Theory of Learning" and that by Prof. S. Ciechanowski, which gives an account of the position and needs of medical science in Poland. The former article contains a close study of the subject, such as might be expected from so thoughtful a scientific worker as Prof. Rybicki, whilst the latter is especially significant since it was only last spring that an important medical congress was held in Warsaw. The considered views which Prof. Ciechanowski now publishes indicate the lines upon which he believes Polish medical science should advance. In this volume, too, Dr. M. Loret announces the results he has obtained from some searches into ancient archives for information concerning the Polish scholars in Italy and at Rome during the sixteenth, seventeenth, and eighteenth centuries. A survey of scientific thought abroad is also included in *Nauka Polska*, and it is interesting to note that lectures recently delivered by Prof. R. A. Millikan ("Science and Society"), Sir James Ewing ("A Century of Inventions", NATURE, **121**, 947; 1928) and Prof. J. F. Thorpe ("Co-operation in Science and Industry", NATURE, **123**, 531; 1929) have been considered of such importance that they are now made available for Polish students. Mention is made also of the formation of the Parliamentary Science Committee in Great Britain last year. Finally, there is a lengthy survey of recent acts and regulations issued by Polish legislative bodies and higher education authorities and an account of the purely educational and scientific (especially biological) aspects of the exhibition held last year at Poznań.

IN connexion with the anniversary of Galen's birth (A.D. 130) a small exhibition has been prepared at the Welcome Historical Medical Museum, 54 Wigmore Street, W.1.

PROF. G. VON HEVESY, of Freiburg im Breisgau, will deliver the Hugo Muller Lecture of the Chemical Society on Wednesday, Mar. 26. The title of the lecture will be "The Chemistry and Geochemistry of the Titanium Group".

DR. W. H. MILLS, University lecturer in organic chemistry in the University of Cambridge, has been awarded the Longstaff Medal for 1930 of the Chemical Society for his distinguished researches in organic chemistry, especially in its relation to stereochemistry. The presentation of the medal will be made at the annual general meeting on Mar. 27.

SURGEON-CAPTAIN SHELDON FRANCIS DUDLEY has been awarded the Chadwick Gold Medal and Naval Prize of £100 for his medical and sanitary work and scientific researches during the past five years and before, directed to the prevention of disease among men of the Royal Navy. The clause of the Chadwick Trust Scheme under which the award is made permits the presentation of a similar prize and medal once in every five years to a medical officer of the Navy, Army, or Air Force who, in the opinion of the Medical Director-General of his arm of the service, shall have in the preceding five years specially assisted in promoting the health of the men of the force to which he is attached.

THE Essex Field Club will celebrate its fiftieth anniversary on Saturday, Feb. 22, when a special commemoration meeting will be held in the Great Hall of the West Ham Municipal College, at which a number of distinguished scientific workers and others interested in the Club will be present. The president of the Club, Mr. D. J. Scourfield, and the Mayor of West Ham will hold a joint reception at three o'clock in the afternoon, and speeches will be made by the Countess of Warwick, the Lord-Lieutenant of Essex, the Chairman of the Essex County Council, Sir Henry Miers, Sir A. Smith Woodward, and Sir David Prain. An evening conversazione will follow, when a special exhibition of natural history and microscopical objects and of topographical photographs and prints of Essex will be made, and lantern lectures will be given by Mr. W. E. Glegg and Mr. S. Hazzledine Warren. The Club's Museum, which adjoins the College, will be closed to the general public, and will be available for inspection by guests on the occasion.

WE have received Part 4 of Vol. 3 of the *Peking Society of Natural History Bulletin* (June 1929. Peping: The China Booksellers. 1.50 dollars.) It contains six scientific articles, of which no less than four are written by Chinese university graduates. The subjects treated include the reproductive system of a Chinese Katydid, the anatomy of water snails, and the taxonomic characters of dragonflies and

Cyclops, all of which are illustrated by black and white plates. The Society is to be congratulated on being able to issue this well-printed journal, which is destined to become the medium for making known zoological discoveries in China.

THE latest catalogue (No. 340) of Messrs. W. Heffer and Sons, Ltd., Petty Cury, Cambridge, gives the titles of nearly 3000 volumes dealing with mathematics, physics, astronomy, chemistry, metallurgy, anthropology, ethnology, botany, agriculture, geology, geography, medicine, physiology, zoology, and biology. It also contains a lengthy list of portraits of men of science.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A senior lecturer in science at the Notts County Technical College and School of Art, Newark—The Principal, County Technical College and School of Art, Newark (Feb. 17). A bacteriologist and pathologist under the County Borough of Belfast and Belfast Port Sanitary Authority—The Town Clerk, Belfast (Feb. 21). A technical assistant under the Directorate of Ordnance Factories of the War Office—The Permanent Under-Secretary of State for War (C.4), War Office, Whitehall, S.W.1 (Feb. 22). Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (Feb. 22). A demonstrator in the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine—The Secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (Feb. 24). A lecturer in physics at Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S.W.3 (Feb. 25). A scientific assistant under the Board of Greenkeeping Research —The Director of Research, St. Ives Research Station, Bingley, Yorks. (Feb. 28). Two junior technical officers in the Admiralty Technical Pool for an Admiralty Experimental Establishment, mainly for work in connexion with acoustical and electrical apparatus—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Feb. 28). An assistant dairy bacteriologist in the Department of Agriculture and Horticulture of the University of Bristol—The Registrar, The University, Bristol (Mar. 1). A scientific research officer in the Irrigation Branch of the Punjab Public Works Department—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Mar. 31). A farm manager and lecturer in animal husbandry and a stockman and dairy instructor at the Arab Agricultural School, Tulkarem, Palestine—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Mar. 31). A professor of physics at East London College—The Academic Registrar, University of London, South Kensington, S.W.7 (April 8). A professor of geography at Birkbeck College—The Academic Registrar, University of London, South Kensington, S.W.7 (April 10). A lecturer in petroleum production, in the Department of Oil Engineering and Refining of the University of Birmingham—The Secretary, The University, Birmingham (April 16). A reader in physics in the University of Dacca, East Bengal, India—The Registrar, the University of Dacca, East Bengal, India (April 30).

Our Astronomical Column.

Prediction of the Sunspot Curve.—Prof. Dinsmore Alter gave an address at the meeting on Jan. 1 of the British Astronomical Association, in which he described researches on the effects of the different planets on sunspot activity. The method adopted was that described by Prof. E. Brown in vol. 69 of *Mon. Not. Roy. Ast. Soc.* Prof. Brown noted that the sunspot period was not very different from the period of Jupiter ; he found that by combining the tidal influences of Jupiter and Saturn he could get a curve that followed that of the observed sunspot activity very closely. His prediction of a late maximum in 1907 was fulfilled ; since then the curve has been carried on to 1955, and its agreement up-to-date with the observed curve is fairly close, though the 1917 maximum is predicted too early. Later, the inner planets were introduced ; since tidal action varies as the inverse cube, this partially compensates for their smaller masses ; the fact of the tidal influence being appreciable is explained by the approximate equilibrium between gravitation and light-pressure at the sun's surface.

Observers' Handbook.—This annual, issued by the Royal Astronomical Society of Canada, is edited by Prof. C. A. Chant, and contains this year a useful catalogue of stars down to magnitude 3·5. It gives magnitude, both apparent and absolute, proper motion, parallax, distance in light years and radial velocity. There is a similar list for stars within 5 parsecs of the sun : the latter list has been steadily growing, and now contains 35 stars, of which only four exceed the sun in luminosity. The one of smallest luminosity is Wolf 359, the absolute magnitude of which is 16·5, implying that its luminosity is one fifty-thousandth part of the sun's. In the list of satellites the name 'Triton' is inserted for Neptune's satellite. This very suitable name was suggested by the late M. Camille Flammarion, and is now adopted by many astronomers.

The Constant of Aberration.—The fact that aberration has an annual period introduces the difficulty of eliminating seasonal effects, due to temperature or other meteorological causes, from measures made for its determination. Mr. H. R. Morgan contributes a paper to *Astr. Jour.* No. 933, in which he deduces a value for the aberration constant from observations in declination of stars near the pole made with the 9-inch transit-circle at the U.S. Naval Observatory, Washington, between 1903 and 1925 ; as the stars were observed at both upper and lower culmination, the observations being made near the beginning and end of the night (at which times the aberration is almost wholly in declination), and each star was observed twice in the year at intervals of 6 months, reasons are given for believing that seasonal terms have been nearly eliminated. This conclusion is supported by the fact that different groups of stars give accordant results. The value adopted for the constant is $20{\cdot}479'' \pm 0{\cdot}008''$. Using Michelson's latest value for the velocity of light, the corresponding distance of the sun is 92,895,300 miles, and its parallax is $8{\cdot}800'' \pm 0{\cdot}003''$.

Research Items.

Migration of Birds and Sex Cycles.—By a series of experiments on the junco (*Junco hiemalis connectens*) Prof. William Rowan has shown that the rhythm of the reproductive organs can be interrupted almost at will by appropriate lighting conditions (*Proc. Boston Soc. Nat. Hist.*, vol. 39, No. 5, 1929). He has thus succeeded in arresting the normal spring recrudescence of the gonads, in causing premature recrudescence in mid-winter, and by alternate over and under lighting causing a maximum recrudescence three times and a minimum reduction twice in the course of a normal single cycle of a year. Further, even in the absence of light, increasing periods of compulsory exercise cause a recrudescence of the gonads. It is suggested, therefore, that the increase of light permits increased exercise and that this is the crucial factor in inducing the development of the gonads. Birds which were released while the sex organs were in process of increasing or dwindling migrated, while those set free at the state of maximum or minimum development showed no inclination to move away. Rowan shows that the spring recrudescence of the sex organs cannot be due to rising temperatures, or the autumnal retrogression to falling temperatures, as has been supposed. While these conclusions apply primarily to the junco, he sees no reason to believe that it is exceptional.

Breeding Habits of South African Frogs and Toads.—Three papers in the *Annals of the Transvaal Museum* (vol. 13, No. 3, 1929) describe the breeding habits and the early development of several species of frogs and toads found in the neighbourhood of Stellenbosch. The appearance of temporary puddles and full drainage furrows following the winter rains is the signal for spawning. The distribution of the spawn shows a certain selectivity of pool conditions on the part of the spawners, and a case of mass spawning illustrated differential survival. In a temporary pool two species of *Rana*, one of *Cacosternum* and one of *Bufo*, spawned one morning and the young hatched, but on the examination of the larvæ when the pool had eventually dwindled to a square foot in area, only examples of *Rana greyi* were found. C. G. S. de Villiers describes the food of the different tadpoles, their characteristics and development, and gives hints for keeping alive and preserving examples for subsequent examination. He warns collectors against preserving amphibian larvæ in alcohol, which invariably results in shrinkage of the tissues and serious distortion. Where field conditions make the narcotising of the larvæ and preservation in a fixative containing sublimate impossible, formalin or carbolic acid is recommended. It would have been convenient had titles been attached to the figures and had a short summary followed the longest paper. V. Fitzsimons and G. van Dam give for the first time an account of the breeding of *Breviceps*.

Californian Salmon.—In a paper on the Sacramento-San Joaquin salmon (*Oncorhynchus tschawytscha*) fishery of California, Mr. G. H. Clark (Division of Fish and Game of California, *Fish Bulletin* No. 17) gives a review of the history of this fishery. A serious decline set in after 1918, and in 1926 and 1927 the commercial catches were lower than they had been in any year since 1874. This is attributed to a depletion brought about chiefly by over-fishing, for which ocean trolling is most responsible, and by dams obstructing streams and cutting off spawning grounds. The author includes in his report a survey of the spawning grounds of the Sacramento and San Joaquin river systems and some information on the life-history of the salmon. It is noted that ocean trolling accounts for the taking of numbers of immature fish as well as mature, and the biological work aimed at ascertaining the age of maturity of the salmon and the percentage of age classes which mature in a given year. It was found that 50 per cent of the fish mature at four years of age, the five-year and three-year fish following in order of abundance. It is thought that 70-90 per cent of the young salmon go to the sea during their first year.

Pelagic Polychætes of the *Terra Nova* Expedition.—The Report on "The Pelagic Polychæta" of the British Antarctic (*Terra Nova*) Expedition, 1910 (Natural History Report. Zoology. Vol. 7, No. 3, British Museum (Natural History), 1929), by Dr. William B. Benham, includes eleven species belonging to three families. Of these the Alciopines are the most important, two new species, both from New Zealand only, being described. These are *Vanadis augeneri* and *Callizona gravieri*. The widely distributed *Alciopa cantrainii* and *Torrea candida* are now shown to occur in the waters round the northern coasts of New Zealand. The Alciopines may be regarded as Phyllodocines which are modified for a pelagic life and are here placed in the sub-family Alciopinæ belonging to the family Phyllodocidæ. Of the four species of *Tomopteris*, most is said about the Antarctic *Tomopteris carpenteri* and there is a long discussion as to whether this species possesses a 'tail'. Apparently it has none, and the tomopterid from South Africa recently described by M'Intosh as *T. carpenteri*, which has a 'tail', seems to be a different species.

Elm Disease.—The so-called Dutch elm disease is so insidious in its spread that any research which throws light on this subject is of great economic importance. J. G. Betrem (*Meded. Laborat. Entomol. Landbouwhoogeschool*, Wageningen, Holland) has published a paper in Dutch, with a German summary, in which he considers it proved that the disease is spread by the elm beetle (*Scolytus scolytus*). In a series of experiments he showed that when beetles are shaken up with distilled water and the water is plated out on nutrient agar, the fungus, *Graphium Ulmi*, now usually considered to be the cause of the disease, dominates the resultant growths. Further, beetles allowed to run over sterile nutrient agar caused much infection by *Graphium Ulmi*, and finally, when the intestines of beetles were removed and inoculated into agar, they gave rise to the fungus almost exclusively.

Afforestation in South Africa.—South Africa is about the only Dominion of the Empire with but a small area of indigenous forest extant. A great deal of attention has therefore been concentrated of late years on afforestation work, mainly with exotics. Dr. H. M. Steven's paper, entitled "Afforestation in South Africa", in the second issue of vol. 3 of *Forestry*, makes it evident that a great deal of high-class work has been undertaken and a considerable experience gained in all the branches which such operations entail. Experience has to be bought by 'trial and error' and careful research. Many problems remain to be answered, but the paper gives evidence that the forestry authorities are on the high road to solving certain questions as to the species which will offer the best hope of success whilst at the same time providing the Dominion with an increasing amount of the types of timber hitherto imported.

Falcon Island : a Pyroclastic Cone.—The December, 1929, number of the *Amer. Jour. Sci.* contains an

interesting study of Falcon Island, an active Tongan volcano, by J. E. Hoffmeister, H. S. Ladd, and H. L. Alling. The island is described as a typical South Sea island in the making. It is a pyroclastic cone built by explosive eruptions. Not a single lava flow has been found on the island, but the pyroclasts, which are mainly of dark brown glass, contain labradorite and pyroxene and are clearly of basaltic type. Many islands of the south-west Pacific have been built up in this way from the Eocene onwards. There is here no evidence that pyroclastic action marks the waning stages of vulcanism. Eua, near Falcon, has a core of volcanic tuff which is overlain by Eocene limestone. White Island, near New Zealand, is a modern representative. Such conditions do not exist in the Hawaiian Islands of the north Pacific. The present Falcon Island is considered to be an example of the first stage of island formation in the South Seas. The second stage is the reduction of the mound of ash and scoria to a shoal or submarine bank. Upon this, organic deposits then accumulate and an atoll may ultimately be produced. A fourth stage is recognised when uplift of the limestone-capped bank takes place, Eua being an example. Falcon Island lies on the well-marked fault line which stretches from Samoa to New Zealand, a line on which many volcanoes, active or dormant, are situated.

Chemical Denudation.—In a report on *Den Kemiska Denudationen i Sverige* (with a summary in French), J. V. Eriksson presents the results obtained during the period 1909–25 by the Swedish Bureau of Hydrography and the National Service of Meteorology and Hydrography in the course of a detailed study of the transport by Swedish rivers of materials in suspension and solution (*Medd. f. Statens Meteorologisk-Hydrografiska Anstalt*, Bd. 5, No. 3, pp, 96, Stockholm, 1929). Work was carried out at 69 stations and 11,313 analyses were made. The final results are given in metric tons of material removed per year from each sq. km. of the areas investigated, the latter covering 57 per cent of the whole country. It is noted that it would be unsafe to assume that the total for the whole country could be obtained from the ratio 57 : 100, since the terrains not yet studied are mainly coastal or argillaceous. In a series of excellent maps, the geographical distribution of the results is presented graphically for inorganic materials; organic materials; CaO ; Cl; and SO_3. Annual and seasonal variations are well brought out by tables of comparative figures. In dominantly calcareous regions chemical denudation removes 60 to 70 tons/km.^{2}/year, whereas in forested areas the figure is generally about 10 tons. Comparison with results for other countries (Europe, North America, and the Nile) shows that in recently glaciated lands chemical denudation makes up 80 to 90 per cent of the total, whereas corresponding percentages are: for the Mississippi 13 to 46; for the Rhone 19 to 66, with an average of 23; for the Blue Nile 17, and the White Nile 72. It is concluded that in Sweden chemical denudation amounts to 70 to 90 per cent of the total.

Isotopes of Nitrogen.—The recent discovery of oxygen isotopes of atomic masses 17 and 18, and of a carbon isotope of mass 13 (see NATURE, Mar. 2 and June 1, 1929, vol. 123, pp. 318 and 831, and Aug. 3, 1929, vol. 124, p. 182) has now been followed up by the announcement by S. M. Naudé in the first number of the *Physical Review* for December of the discovery of an isotope of nitrogen of mass 15. If this existed, it should produce some additional band heads near 2156 A. in the spectrum of nitric oxide, and a search for these indicated that they were actually present, very close to the predicted positions. The bands were examined in absorption, and the possibility that the reputed isotope effect was due to the presence of molecules such as $(NO)_2$ ruled out by the fact that the relative intensity of the various band heads was independent of the pressure of the nitric oxide. Nitric oxide $N^{15}O^{16}$ is about as abundant as nitric oxide N^{14} O^{18}. Some very faint absorption lines have also been observed which agree with those calculated for the molecule $N^{16}O^{16}$, but the existence of this third isotope, of atomic mass 16, must still be regarded as uncertain.

An Ammeter for High Frequency Currents.—The problem of measuring alternating currents of very high frequency has come rapidly to the front during recent years owing to the extensive use of radio-communication. In the early days of electric supply, power engineers sometimes thought that possibly there were large losses in their mains owing to the so-called 'skin effect'. This effect caused an uneven flow of current across the section of the main, the current density as a rule being greatest near the surface. One of the advantages of concentric mains in the old days was supposed to be that they largely diminished this loss. It is only, however, when the mains are very large that this loss becomes notable at the standard power frequency of 50. When frequencies of 100 million are used, as in radio work, the skin effect becomes enormous, and many attempts have been made to obviate the difficulties it causes. At this high frequency an ordinary ammeter would, owing to its inductance, allow practically no current to flow in the circuit. In a paper read to the Institution of Electrical Engineers on Feb. 5, Prof. C. L. Fortescue described an ammeter he has invented which practically overcomes all the difficulties hitherto experienced. He points out that these difficulties arise from three main causes: That the capacity effects make the current in the instrument different from the current outside; secondly, even very short conductors have a high inductive reactance at high frequencies; and thirdly, the presence of the measuring device in the circuit changes the value of the current that has to be measured. He gets over the difficulty by using a thin wire screened by and coaxial with a concentric cylinder. The instrument is calibrated with direct current, and he shows how the true current can easily be calculated by theory.

Laboratory Hot-Water Ovens.—We have received from Messrs. Brown and Sons, Ltd., 9 Wedmore Street, Holloway, N.19, an illustrated booklet which contains particulars of the patent 'Sanbro' laboratory hot-water ovens. By means of a very simple device the boiler at the base of the oven can be removed, cleaned, and replaced within a few minutes and without the use of special tools. Moreover, when the deposit in the boiler becomes excessive, the latter can be replaced by a new one at a small cost. The boiler consists of a loose pan to the inside of the top rim of which is fixed a gutter into which the oven proper fits. The two parts when fitted together form the steam chamber, an air-tight connexion being produced merely by a layer of water which forms an effective seal. The ovens, which have already been installed in many laboratories with satisfactory results, can also be combined with water-stills. The great advantage of this new device will be at once apparent to anyone who has had to incur the cost of repairs to oven-stills of the older type, in which hard water has been continuously used. The device can be fitted without much trouble to existing ovens of the sealed-up type and can be adapted to various kinds of heating supply.

Chemical Warfare.

DR. HERBERT LEVINSTEIN, in a lecture delivered on Feb. 3 before the London section of the Society of Chemical Industry, courageously examined the position of chemical disarmament and chemical warfare in relation to the ideals and foundations of future peace and to the stern realities of the dangers of conflict. Whilst it is probably true that man is by nature a peaceable creature, and hence amenable to the settlement of domestic disputes peaceably under compulsion of law, the extension of the same principle to international disputes, however devoutly to be sought, is not so simple as may appear. The necessities of life are provided for the individual who falls in the social struggle, but not for the nation which succumbs in society organised on competitive principles, and the possibility of defensive resort to arms remains in the background of international agreements. Hence with the present organisation of society the possibility of fighting is never remote, and Dr. Levinstein's first plea was for the strengthening of the efforts of the League of Nations in making wars on a large scale less probable.

In international disputes, arms are the last resort; other means of persuasion are equally available, and not the least powerful is the possession of a powerful chemical industry. Restriction of naval armaments, largely an economic measure, by making war cheaper tends in a sense to make it easier, and in Dr. Levinstein's opinion increases the importance of the chemical arm. Examination of the text of the agreements relating to the prohibition of chemical warfare leads to the conclusion that the prohibition is largely ineffective. He finds, for example, no prohibition of the use of screening smokes; yet it may be argued that such smokes as that of chlorosulphonic acid are in concentrated form deleterious to the human organism and are therefore forbidden. Justification of the use of a smoke can be based on the grounds that its toxic properties are accidental, as indeed are those of the fumes from high explosive shells. Tear gases, used in the United States for the protection of banks and safe deposits and for dealing with riots and civil disturbances, may be classed as non-asphyxiating and non-poisonous, since in low concentration they affect the eyes alone.

Chemical warfare has not, said Dr. Levinstein, been justly condemned by the general opinion of the world; condemnation lies against its use by the Germans in 1915 in violation of the spirit, if not of the letter, of the Hague Convention, and because it was used against unprotected troops. He asked why preference should be shown for the use of high explosives with their ghastly effects; there is, unfortunately, no prohibition against the dropping of high explosive shells or incendiary bombs from hostile aircraft at dead of night on crowded cities.

The object of war is not to destroy human life, but to break down the opponent's will to resist. Gas, Dr. Levinstein claimed, maims or kills a far smaller proportion of those whom it puts out of action than does any other weapon used in the recent War; thus in proportion to the military results it causes far less human suffering, and, in addition, less of the wasteful destruction of the work of man. Dr. Levinstein quoted statistics showing that of the casualties caused by gas only 2-3 per cent died and few—about 0·5 per cent—were permanently injured, whilst of casualties resulting from all other forms of warfare 25-33 per cent died, and of the survivors 2-5 per cent were maimed, blinded, or disfigured for life. He did not suggest that gas warfare is anything but dreadful, but he argued that it is both less dreadful and of greater military value than the older forms of warfare. It causes inconvenience, holds the element of surprise, permits economy of force, and is equally serviceable in attack and defence.

In Dr. Levinstein's opinion it is an elementary act of prudence for a nation situated as is Britain to see that research for chemical warfare purposes should continue to be a subject for special study, and that funds for that purpose should not be reduced below the safety point. Guns and shells can be restricted, and in any case take long to prepare, but gas can be projected from quickly improvised containers; limitation of armaments as proposed may therefore greatly increase the military importance of the chemical weapon, and prudence dictates contact in peace time between military authorities and the chemical industries.

If a purely general observation supplementing Dr. Levinstein's remarks may be offered, it is simply that modern warfare in all its forms is increasingly based on chemical knowledge, and that if chemical research can make warfare even a little less probable and less hideous, its potentialities in that direction deserve the attentive interest and unbiassed support of all right-minded men and women.

Variations in the Skeletal Structure of the Pig.

HAVING observed marked variations in the lengths of exhibition carcases of swine used for bacon curing, Prof. A. M. Shaw, of the University of Saskatchewan, suspected that the difference might be due to variations in the numbers of ribs. He accordingly counted them and found that, of nine carcases exhibited, two possessed 16 pairs of fully developed ribs, four possessed 15 pairs, while the remaining three carcases possessed 14 pairs of fully developed ribs each.

Reference to standard works on veterinary anatomy was made. Sisson states: "The ribs number fourteen or fifteen pairs. The fifteenth rib when present may be fully developed and its cartilage enter into the formation of the costal arch; but in most cases it is only about an inch (2-3 cm.) in length." The vertebral formula given by Sisson is: *C* 7, *T* 14-15, *L* 6-7, *S* 4, *Cy* 20-23. He also states that "the occurrence of fifteen thoracic vertebræ is quite common and the existence of sixteen or even seventeen has been recorded. Reduction to thirteen is very rare." Various model pig skeletons examined by Shaw all possessed what was apparently considered to be the normal number, namely, 14 pairs.

Prof. Shaw has had careful counts made in Canada, the United States, Great Britain, and Denmark, and has now published the figures for 3957 animals, representing several breeds, grades, and crosses (*Scient. Agric.*, **10**, 1; September 1929). When summarised they show the following results: 13 pairs of ribs, 20 pigs; 14 pairs, 1574 pigs; 15 pairs, 1829 pigs; 16 pairs, 310 pigs; 17 pairs, 7 pigs. The remainder showed uneven pairs or floaters. More than 400 vertebral columns were scraped and cleaned for identification, varying in number of ribs from 13 to 17. The counts showed that cervical (7) and sacral (4) remained constant, thoracic varied according to the number of ribs, while the lumbar variation is from 6 to 7, except in two cases, where there were only 5 present. The true ribs were always attached to

thoracic vertebræ and the increase in lumbar vertebræ were associated with the smaller number of ribs present and vice versa. There appeared to be no relationship between sex and the number of ribs. Very interesting observations were made in regard to litter mates in that "no normal litters were found where all pigs possessed the same rib number".

In addition to the scientific value of these observations, the economic aspect of rib variation in pigs is of considerable importance from the point of view of bacon, since the increased length of the carcase is mainly in that region usually regarded as furnishing the prime cuts. The awards in various competitions supports this, even though the judges apparently had no thought of rib count. Moreover, in a private communication Prof. Shaw states "there seems to be ample evidence that the animals with fifteen and sixteen pairs of ribs are decidedly superior from the standpoint of rate of growth and economy of gains to those possessing thirteen or fourteen pairs".

The Sugar Industry.

THE world's sugar industry was the subject of the Streatfeild Memorial Lecture delivered at the Institute of Chemistry by Mr. Lewis Eynon, on Nov. 22, 1929, and recently published. Sugar cane, which until about 130 years ago, was the only source of sugar, was known before the Christian era, and is supposed to have originated in India. Arabs and Egyptians, however, were the pioneers in the art of crystallising sugar many centuries later. Sugar appears to have been first imported into England from the Mediterranean countries in the fourteenth century, and the art of refining introduced during the reign of Henry VIII. During the seventeenth and eighteenth centuries, however, the bulk of the world's sugar was derived from America and the West Indies, where abundant slave labour and good growing conditions particularly favoured the industry.

Attempts to produce sugar from sources other than cane were first made in Europe during the Napoleonic Wars, when the possibilities of utilising grapes and beetroot were investigated, but without much success in the former case. With the exception of France, where the industry obtained government support, it was short-lived, and did not become general in Europe until 1860.

Despite the development of the beet sugar industry, the importation of cane sugar into Europe continued to increase for some time, and although during the latter part of the nineteenth century the cane sugar industry suffered temporarily from severe competition, the markets gradually adjusted themselves, and in 1901–2 cane and beet each contributed about 50 per cent of the world's production of sugar. Sugar beet growing was first attempted in England seventy years ago; but the industry developed but little until the raising of the subsidy in 1925.

Besides the cane and beet sugar industries, the production of glucose from starch, first discovered in 1811, is an important manufacture. Improved methods, the discovery of new sources of sugar, and the extension of the industry into temperate climates have enormously increased the world's supply of sugar.

Although sugar, at one time a luxury, has now become an important article of food, human consumption is not likely to increase at the same rate as the supply, and it seems that a new use for sugar must be found, or further growth of the industry will be impossible. The production of power alcohol from sugar seems to be the solution of the problem, and it would also provide a useful substitute for petrol before the world's store of this is exhausted. The future prosperity of the sugar industry would thus seem assured.

Bacterial Infection in Fish.

IN the issue of NATURE dated Dec. 29, 1928 (p. 1012), there appeared a short notice of recent work on furunculosis in Salmonidæ by Dr. Clayton and Miss I. J. Williamson working independently. Since then, Miss Williamson has continued and extended her studies on this disease, the results of which are embodied in two papers recently published by the Fishery Board for Scotland. The external signs and visceral changes in furunculosis she finds to be variable, and there may be no external symptoms, isolation of the bacillus (*B. salmonicidus*) often being the only method of diagnosis.[1] A notable and very important feature of the disease is that apparently healthy fish can act as 'carriers' of the bacillus, but no means has as yet been evolved for distinguishing such 'carriers' from uninfected fish while still alive. Rainbow trout can also be attacked by the disease, and act as 'carriers' of it. It is interesting further to note that, up to the present, no case of furunculosis has been found among salmon smolts or among kelts, nor have any such fish been found to be 'carriers', but too few fish have as yet been examined to attach any but provisional value to this statement.

In the course of her investigations into furunculosis of Salmonidæ, the author has made additional general observations on bacterial infection in fish and certain other lower vertebrates.[2] It is found that organisms, naturally saprophytic, may under certain conditions become pathogenic. These organisms comprise types frequently found in water, such as *B. fluorescens* and certain Gram-negative, non-sporing, non-chromogenic bacilli.

Bacterial disease of fish and frogs usually takes the form of a general infection. Focal lesions may or may not be found. In furunculosis, infection may be both focal and general. Secondary infections, including ante-mortem infection, are of common occurrence in fish and frogs when the resistance of the animals has been lowered by primary infection, injury, and (possibly) other adverse conditions. Little or no tissue reaction against invading bacteria analogous to such reactions in mammalian animals has been found in frogs or fish, but a certain degree of phagocytic activity is displayed in some cases. "It seems certain", says the author, "that many water organisms are potentially pathogenic for fish, so that when they are injured or their resistance lowered by adverse conditions, these organisms invade their tissues and usually produce a general infection. Once bacteria have gained an entrance, they meet with but little opposition from the tissues and rapidly overrun the body."

[1] Fishery Board for Scotland. Salmon Fisheries, 1929, No. 1: Further Studies on Furunculosis of the Salmonidæ, 1928. By Isobel J. F. Williamson. Pp. 12. (Edinburgh and London: H.M. Stationery Office, 1929.) 6*d*. net.

[2] Fishery Board for Scotland. Salmon Fisheries, 1929, No. 2: A Study of Bacterial Infection in Fish and certain other Lower Vertebrates (with a Systematic Account of the Bacteria isolated from Fish and Frogs in the course of investigation of Furunculosis of the Salmonidæ). By Isobel J. F. Williamson. Pp. 28. (Edinburgh and London: H.M. Stationery Office, 1929.) 1*s*. 9*d*. net.

Historic Natural Events.

Feb. 16–19, 1898. Dust Haze.—A dense haze occurred over a large part of the eastern Atlantic off West Africa, extending for at least 1500 miles north and south and a great but unknown distance east and west. The haze was caused by very fine red dust, so fine that it was impossible to sweep it up, and so dense that the sun and stars were completely obscured for two days. When visible the sun was generally red, but one observer described it as "a perfect blue ball" and another as greenish. At Teneriffe the occurrence was preceded by a strong and very hot southerly wind, but during the haze there was no wind. Many insects were observed, of species not generally found on the island. The dust evidently originated in Africa, for it was much coarser near the coast, and was thrown overboard from ships in large quantities.

Feb. 18, 1770. Damage by Lightning.—During morning service St. Keverne's Parish Church, Cornwall, was struck by lightning. The vicarage seat was torn to pieces and a large piece of oak was thrown 20 feet. The vicar's sister was knocked down senseless, the wooden part of one of her pattens was broken and it and her shoe were burnt, as well as parts of her clothes and body. The spire was rent, and stones from it were thrown on the tops of many houses; one that fell through a roof was found to weigh 14 lb. Some smaller stones were found at a distance of a quarter of a mile.

Feb. 20, 1661. The 'Dantzig Phenomenon'.—A remarkable and extremely beautiful halo complex was seen at Dantzig between 10.30 and 11.51 A.M. In addition to the usual halos of 22° and 46°, the circumzenithal ring and various arcs of contact, there were no fewer than seven mock suns, some white, some of various colours, arranged with perfect symmetry. This is probably the most complete optical display on record.

Feb. 20, 1835. Great Earthquake.—Concepcion, Talcahuano, and other Chilean towns were ruined by an earthquake felt over an area of more than 400,000 square miles. Sea-waves, 28 feet and more in height, swept over the coast and even caused damage at Juan Fernandez, 420 miles from Chile. The coast of Chile was raised by 4 or 5 feet, though it afterwards subsided by half that amount. The volcanoes of the Chilean Andes, a range 150 miles in length, were unusually active before, during, and after the earthquake.

Feb. 21, 1861. Great Storm in Southern England.—This storm was noteworthy for the destruction of a wing of the Crystal Palace and of the cathedral tower at Chichester, which fell in spite of desperate efforts to shore it up.

Feb. 21, 1922. Glazed Frost.—During the night of Feb. 21, in the region of the Great Lakes, a light rain fell at a temperature below freezing point. A coating of ice formed on everything out of doors, and as the rain continued falling, the ice grew thicker. Trees were so heavily coated that they began to give way and the air was full of rifle-like reports as the huge limbs snapped off. Sidewalks in streets were piled high, and as the rain continued whole streets became blocked as the trees were split from top to base and fell. Trains ceased to run, and telegraph and telephone wires were snapped by the weight of ice. Newspaper presses stopped, and only the radio enabled people to keep in touch as they could not venture into the streets. Recovery was slow. The train service resumed after several days, but it was months before all the telegraph equipment was replaced.

Feb. 21–23, 1903. Red Rain.—Dust or 'red rain' fell over an area of 20,000 square miles in the southern half of England and Wales as well as in many countries on the Continent. It is estimated that in England and Wales alone the total quantity of dust was not less than 10 million tons. It was traced back to the Sahara, south of Morocco, where it was raised by a strong north-east wind; it travelled on the western side of an anticyclone over south-west Europe for a distance of at least 2000 miles in a wide sweep around Spain and Portugal, probably across the Azores. In Europe the fall was associated with oppressive heat, and visibility was limited to short distances.

Feb. 22, 1909. Meteor Trail.—A very fine meteor passed the length of the English Channel at 7.34 P.M. from a point 45 miles south-south-west of Beachy Head to 87 miles south-south-east of Start Point. This distance of 150 miles was traversed in less than six seconds, giving a velocity of at least 25 miles per second relative to the earth, at a height of about 50 miles. The meteor left an unusually well developed 'streak', which was visible for nearly two hours. It brightened appreciably in the first half-minute, and the main part drifted gradually north-westward while the ends remained almost stationary. The long-continued brightness of the streak was attributed to some unknown form of electrical action, possibly similar to the aurora, rather than to incandescent matter.

Societies and Academies.

LONDON.

Royal Society, Feb. 6.—A. H. Davis and E. J. Evans: Measurement of absorbing power of materials by the stationary wave method. The paper describes an apparatus set up for determining the acoustical absorption coefficient of small samples of material for sound, incident perpendicularly, and discusses the theory of the method and of its corrections. Stationary wave coefficients for certain practical materials are compared with coefficients obtained by a 'reverberation' method, in which random incidence of sound is employed.—J. W. Fisher and H. T. Flint: The equations of the quantum theory. These equations are obtained by analogy with Maxwell's equations applied to empty space. They are expressed by means of a five-dimensional system of co-ordinates with the adoption of a metric after the manner of Weyl and Eddington in four-dimensions. The quantum problem is shown to be a radiation problem in five-dimensions, and the equations proposed are invariant.—J. Hargreaves: The effect of nuclear spin on the optical spectra (2). The paper contains a general method for dealing with the effect of a nuclear spin of possibly more than half a quantum, by the use of multiple wave functions, and is applied in detail to the cases of a nuclear spin of 1, $1\frac{1}{2}$, and $4\frac{1}{2}$ quanta respectively. The interaction energy of the nucleus and electron spins is neglected, without effect on the kinematical problem of determining the multiplet intensities.—E. Rudberg: Characteristic energy losses of electrons scattered from incandescent solids: The velocity distribution of an initially homogeneous beam of electrons, after scattering from a solid target kept at incandescence, has been studied by means of a magnetic deflection apparatus. The curves show a sharp peak due to reflected electrons and several small maxima for slightly lower values of the energy. These maxima are characteristic of the substance forming the target, their positions with respect to the reflected peak remain constant for a wide range of bombarding voltages, and when target and electron gun are rotated, are also independent of angle of scattering. These maxima are associated with

inelastic collisions with the target atoms, involving definite energy changes, such as excitation and ionisation.—J. A. Gaunt: Continuous absorption: This paper investigates afresh the problem of the rate of absorption of light by electrons which are initially bound to a nucleus, or free and 'colliding' with a nucleus, and after absorption are free in either case. Such a process gives rise to a continuous absorption spectrum and is the main source of the general opacity in stellar atmospheres and interiors. The interest and difficulty of the problem lie in the effective evaluation of the formal quantum theoretical expression for the absorption coefficient. Kramers' classical formula is asymptotically correct in the region in which one would expect it to be so by the correspondence principle. The deviations of astrophysical significance are found. The discrepancy between the requirements of Eddington's stellar theory and Kramers' formula is probably retained by the quantum theory of continuous absorption.

Optical Society, Jan. 16.—O. G. Hay: The Ross modification of the Hilger interferometer is for testing large optical elements when the free aperture of the test element is larger than the normal aperture of the interferometer. A pair of mirrors moved over the surface to be tested reflect a test beam and a reference beam and so enable any two areas to be compared. Any error introduced, by mechanical motion, into the test beam is compensated by a similar error in the reference beam. The two beams are linked together throughout the whole of the optical train of the interferometer.—J. S. Preston: The reflection factor of magnesium oxide. The factors were measured by means of a small integrating hollow sphere with three openings, one for illumination, another for observation through a photometer, and the third covered by a test plate or by the specimen to be examined. Results. Total factor under diffused light = 0·0974.

Apparent factor for	90°	incidence and	45°	view	=	$1{\cdot}00_5$.
,, ,, ,,	45°	,, ,,	90°	,,		$1{\cdot}00_0$.
,, ,, ,,	diffuse	,, ,,	45°	,,		1·00.
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EDINBURGH.

Royal Society, Feb. 3.—R. W. Wrigley: On changes of rock temperatures and irregularities of the earth's rotation. The investigation is based upon a series of deep rock temperatures dating from 1837 taken at the Calton Hill. After the removal of the effects of atmospheric changes at the surface, the residuals show a certain fluctuation. A fifty years' series of deep soil temperatures at Greenwich, when similarly treated for the removal of surface variations, shows similar fluctuations. There is a close correlation between these temperature variations and the minor fluctuations in the moon's longitude. Sliding of the earth's crust over the core combined with more local variations of longitude may cause the latter, and the rock temperatures would be influenced by the consequent changes of pressure in intermediate layers of the earth's crust. —S. Williams: The morphology of *Trichomanes aphlebioides* Christ, with special reference to the Aphlebioid leaves. *T. aphlebioides* is endemic to New Guinea where it grows on tree trunks in humid forests. It was first collected by K. Lauterbach in 1890 and briefly described by Christ in 1901. The scandent rhizome possesses a protostele similar to that of *T. scandens*. The fronds measure up to 60 cm. long and are 4-5 pinnate. In addition to these normal fronds, the plant possesses hair-like aphlebioid leaves. These latter are borne singly at the nodes, and their position and structure indicate that they are the first fronds of the axillary branches. Anatomically they show great reduction in relation to the moist and shady habitat. They may serve to promote transpiration and possibly also to protect the young fronds.—J. S. Patel: The presence of a kuogenic substance in the corpus luteum of the cow: The corpus luteum of the cow contains not only a hormone which produces the pregnancy changes in the genital tract (corpus luteum hormone, beta factor), but also a water-soluble substance which induces beta production in the ovary of the immature mouse. This substance was mistaken by many authors for corpus luteum hormone. It resembles certain pituitary extracts in action and chemical behaviour and is perhaps identical with the supposed RHO-2.—P. Koller: Genetic studies on the *A* and *B* races of *D. obscura*. The taxonomist cannot distinguish *A* from *B*, but cytologically and genetically they are dissimilar. The racial hybrid male is infertile the female fertile. Experiment involving the use of several sex-limited characters and crossing-over showed that the only male which was fertile was one with a *Y*-chromosome of race *B* and a racially compound *X*, the ends of which were from *B*, the middle from *A*. Crossing over in the ends of the *X* was greatly reduced in the case of the racial hybrid. There are probably genes in the ends of the *X*, physiologically dissimilar in the two races, which determine fertility. The relation of puberty to testis size and to cytoplasmic constitution is examined. No such relation exists.—F. A. E. Crew and L. Mirskaia: Maturity in the female mouse. Puberty and maturity are distinguished and defined. In this study the albinos reached puberty earlier than did the coloured; in them the cornified stage of first œstrus lasted longer before mating, and more commonly they mated at the time of the first œstrus. Pregnancy following the first œstrus was more frequent.—Alan Mozley: Reports of the Jasper Park Lakes Investigations, 1925–26. The mollusca of Jasper Park. The Biological Board of Canada sent two expeditions under the charge of Dr. Chas. H. O'Donoghue to Jasper National Park in the Canadian Rockies to investigate the possibilities of augmenting its fishing facilities. The present report deals with the Mollusca mainly from the systematic point of view. Forty-seven species or varieties are recorded and described, and while none of them are new they nearly all vary from the previously known forms. The collection is noteworthy in two respects: first, all the specimens were taken at altitudes between 4000 ft. and 7000 ft.; and secondly, no such detailed study of fresh-water mollusca has been made within a radius of 2000 miles. This report is intended to be preliminary to one dealing with the ecology of the group.

PARIS.

Academy of Sciences, Jan. 6.—Gabriel Bertrand and M. Mokragnatz: The distribution of nickel and cobalt in plants. Nickel and cobalt have been found in all the plants examined. The quantities of nickel found, expressed on the dry material, range from 0·02 parts per million in polished rice to 3·5 parts per million in an edible fungus, *Cantharellus cibarius*. The proportions of cobalt are usually from one-fifth to one-tenth of the nickel present.—Paul Pascal: Amides and imides derived from vanadium. A study of the interaction of ammonia and vanadyl chloride at different temperatures. At −80° C. vanadyl amide, $VO(NH_2)_3$ is produced, but cannot be separated from ammonium chloride: at 85° C. or higher temperatures the imide VONH is formed.—V. Lalan: The fundamental tensors of plane varieties.—Jacques: Certain networks traced on quadrics.—Maurice Janet: A series of functions considered by Hermite and its application to a problem of the calculus of variations. —R. Tambs Lyche: A problem of interpolation.—

Vladimir Bernstein: The regions of holomorphy of the series of Dirichlet.—Giulio Krall: The variation of domain in the problem of Dirichlet.—Fr. Girault: The law of gravitation.—Maurice Nuyens: A new method of integration of gravific equations of a massic and electromagnetic field with spherical symmetry.—J. F. Cellerier: The scientific analysis of musical sounds. The principle of the method employed is based on the conversion of the acoustic phenomena into electrical vibrations the characteristics of which can be determined with a high degree of precision. As an example, the results of the examination of the note emitted by a motor horn is given.—J. B. Galle and G. Talon: Researches relating to the propagation of radioelectric waves carried out on the occasion of the eclipse of May 9, 1929. In recognition of the importance of researches on the propagation of radioelectric waves in its relations with solar activity, arrangements were made, on the occasion of the solar eclipse expedition to Indo-China, to carry out measurements of the electric field produced by distant wireless stations, observations on atmospherics, and the apparent variations of emitting station as given by radio goniometry. A summary of the results obtained is given.—G. Ferrié: Remarks on the preceding note. Comments on the results obtained in connexion with retarded wireless echos.—J. Perreu: The limiting heat of solution of hydrated manganese chloride.—R. Levaillant: Some reactions of sulphurous and carbonic esters. Description of the preparation and properties of the compounds $SO_3[CH(CH_2Cl)_2]$, $(CH_2Cl)_2 . CH . SO_3Cl$, and $(CH_2 . CH_2Cl)_2SO_4$.—M. Tiffeneau, Mlle. Jeanne Lévy, and E. Ditz: Some pairs of amino alcohols. The preparation of each isomer separately. In the preparation of the amino alcohols $ArAr'C(OH)CH(NH_2)CH_3$ by the interaction of the organo-magnesium compounds with amino ketones, either of the two stereoisomeric forms predicted by theory can be obtained at will by inverting the order of introduction of the radicles Ar and Ar'.—Raymond Delaby and Raymond Charonnat: The synthesis of dioxypyramidon.—Pierre Viennot: Intrusions of the Trias in the Adour basin.—Marcel Casteras: The structure of the mountains of Gar and Cagire (Haute-Garonne).—Louis Dangeard: Algal reefs and pebbles in the ferruginous oolite of Normandy.—Mlle. A. Dusseau: The chlorophyll of the leaves of wheat. Physical measurements of alcoholic extracts of chlorophyll may serve for the identification of the variety of wheat.—Alphonse Labbé: The pallial organs of some Doridida.—A. Policard and M. Boucharlat: Contribution to the study of pulmonary anthracosis. The tolerance of cultures of tissues towards particles of coal. Results of growing lung tissue from the embryo fowl in plasma containing fine particles of coal in suspension. No poisonous action of the coal could be detected. These experiments tend to confirm the view that pulmonary anthracosis is an anatomical state and not a disease.—C. N. Dawydoff: The larvæ of the Polyclades of the coasts of Annam.—Emile F. Terroine and Fr. Szucs: The relation between aminopuric nitrogen and proteid nitrogen in micro-organisms.—H. Hermann, F. Caujolle, and F. Jourdan: The elimination of some alkaloids and some genalkaloids by the bile ducts. The presence in the bile of quinine, nicotine, strychnine, and genostrychnine, atropine, and genatropine has been proved.—R. Fosse, A. Brunel, and P. de Graeve: A new fermentation of uric acid produced by the liver of various animals. Uric acid can be totally converted into allantoin by a ferment in horse liver or by the liver of *Rana viridis*.—Mlles. Marguerite Champagne and Gilberte Mourot: The estimation of allantoin in animal urine.—J. Magrou: The interpretations of biological actions at a distance.—H. Bordier: The efficacy of medical d'Arsonvalisation in erythematous lupus.

GENEVA.

Society of Physics and Natural History, Nov. 21.—G. Tiercy: The new refrigerating installation of the chronometric department of the Observatory of Geneva. The Observatory of Geneva has recently completely reorganised its chronometer service. In particular, an apparatus has been set up for testing chronometers with a modern automatic refrigerator; this installation can keep a temperature in the chronometer chamber which is constant within 0·2° C. The same constancy can be maintained in the chambers used for higher temperatures.—R. Wavre: A possible agreement between geodesy and the theory of the precession of the equinoxes. D'Alembert put the following problem: Are the geodesic measurements of the terrestrial flattening entirely included between the limits which are assigned to them by the theory of precession? Poincaré showed that the studies, to the first approximation, of Clairaut and his successors led to a disagreement. He did not determine the agreement possible using the second approximation. The author, who has made a methodical study of the second approximation, shows that this agreement is possible. The problem of D'Alembert may be solved without abandoning the fluid character of the earth considered as a whole.—E. Briner and H. Kuhn: Some new ammonia addition compounds of phenols. On the basis of a manometric method, the authors have detected and characterised by their formulæ, dissociation pressures and heats of formation, numerous new compounds formed by ammonia with phenols, naphthols, oxy-anthraquinones, and substituted derivatives of these substances.—B. Susz and E. Briner: The true energy yields in the production of ozone by the silent discharge and their improvement. The authors have established by electrical and calorimetric methods the true yields in the production of ozone by the silent discharge. These yields, improved by cooling, exceed 200 grams of ozone per kilowatt-hour. This makes the use of ozone particularly economical.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 20, 1929).—P. Lazarev and L. Teile: The action of blood-vessel dilators on the sensitiveness of the eye in peripheral vision. Experiments were made with amyl nitrite and nitroglycerine and it was found that these substances cause after the first 1-3 minutes a sharp decrease in the sensitiveness of the eye; then an increase occurs and after 5-9 minutes the sensitiveness becomes more than double the normal minimum.—P. Lazarev and N. I. Kolesnikova: The staining of boric glass by the action of radium rays. No effect has been observed from the action of γ-rays; β- and γ-rays acting together produce a purplish-brown stain; the combined action of α- and β-rays results in producing a substance with a high absorption in the blue part of the spectrum and smaller absorption in the red part. The substances produced by α- and β-rays possess a different velocity of reverse transformation under the influence of benzole and of high temperature.—P. Lazarev and N. Rodzevitch: The phenomena of ionisation of a gas during the discoloration of colouring substances in visible and in ultra-violet light. While there is no ionisation effect when cyanine is discoloured by the action of ordinary light, the action of ultra-violet rays produces ionisation. Similar results have been obtained with crystal violet.—A. N. Tsvetkov: The theory of physiological units. The physiological unit is the

minimum quantity of the living substance which is still excitable. Theoretical calculations show that the unit should be about μ^3 in size.—A. I. Leskov: The occurrence of *Buxus sempervirens* L. in the northern Caucasus. The forests in which boxtrees are found contain about 75 per cent of species of plants which must be regarded as Tertiary relics.

Official Publications Received.

BRITISH.

Memoirs of the Punjab Irrigation Research Laboratory, Lahore. Vol. 1, No. 3: A Statistical Examination of the Discharge of the Indus at Sukkur and its Relation with Up-stream Sites. By B. H. Wilsdon, with R. Partha Sarathy. Pp. 40. (Lahore.) 1.12 rupees; 2*s*. 4*d*.

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 96, December. Pp. 95-150. (London: Williams and Norgate, Ltd.) 5*s*. net.

The British Electrical and Allied Industries Research Association (Incorporated). Ninth Annual Report, October 1, 1928, to September 30, 1929. Pp. 75. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 18: Notes on the Development of Callichthys littoralis. By Frances M. Ballantyne. Pp. 437-466+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s*.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 12, December 1929. Abstracts Nos. 2444-2646. Pp. v+425-548. (London: H.M. Stationery Office.) 9*d*. net.

The Marine Biological Station at Port Erin (Isle of Man): being the Forty-third Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool. Drawn up by Prof. Jas. Johnstone. Pp. 31. (Liverpool: University Press of Liverpool.) 1*s*. 6*d*. net.

The North Staffordshire Field Club. Transactions and Annual Report, 1928-29. Vol. 63. Pp. 173. (Stafford.) 7*s*. 6*d*.

Geological Survey Department, Tanganyika Territory. Short Paper No. 4: The Soil and Agricultural Development in relation to the Geology of portions of the Northern Kigoma and Southern Bukoba Provinces. By Dr. E. O. Teale. Pp. 32. (Dar-es-Salaam: Government Printer.) 4*s*.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929, Vol. 41, January. Pp. 885-981. (London.)

Dominion Museum, Wellington, New Zealand. Bulletin No. 12: Fishing Methods and Devices of the Maori. By Elsdon Best. Pp. viii+230. (Wellington, N.Z.: W. A. G. Skinner; London: New Zealand Government Office.) Paper, 9*s*.; cloth, 11*s*.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 607: Surface Water Supply of the United States, 1925. Part 7: Lower Mississippi River Basin. Pp. iv+113. 20 cents. Water-Supply Paper 608: Surface Water Supply of the United States, 1925. Part 8: Western Gulf of Mexico Basins. Pp. vi+268. 30 cents. Water-Supply Paper 609: Surface Water Supply of the United States, 1925. Part 9: Colorado River Basin. Pp. v+145. 15 cents. Water-Supply Paper 610: Surface Water Supply of the United States, 1925. Part 10: The Great Basin. Pp. v+141. 20 cents. Water-Supply Paper 613: Surface Water Supply of the United States, 1925. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+271. 30 cents. Water-Supply Paper 614: Surface Water Supply of the United States, 1925. Part 12: North Pacific Slope Drainage Basins. C: Pacific Slope Drainage Basins in Oregon and Lower Columbia River Basin. Pp. vi+198. 30 cents. Water-Supply Paper 636-B: Suspended Matter in the Colorado River in 1925-1928. By C. S. Howard. (Contributions to the Hydrology of the United States, 1929.) Pp. ii+15-44. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Bulletin 810-B: The Chandalar-Sheenjek District, Alaska. By J. B. Mertie, Jr. (Mineral Resources of Alaska, 1927-B.) Pp. ii+87-139+2 plates. Bulletin 812-B: The Kevin-Sunburst Oil Field and other Possibilities of Oil and Gas in the Sweetgrass Arch, Montana. By Arthur J. Collier. (Contributions to Economic Geology, 1929, Part 2.) Pp. iv+57-189+plates 11-18. 30 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Professional Paper 158-B: The Contact of the Fox Hills and Lance Formations. By C. E. Dobbin and John B. Reeside, Jr. (Shorter Contributions to General Geology, 1929.) Pp. ii+9-25+plates 4-5. (Washington, D.C.: Government Printing Office.)

Contribution from the Cenozoic Laboratory of the Geological Survey of China and the Department of Anatomy, Peking Union Medical College, Peking. Vol. 8, No. 1. Bulletin of the Geological Survey of China. Preliminary Note on Additional *Sinanthropus* Material discovered in Chou Kou Tien during 1923. By Prof. Davidson Black. Pp. 15-20+6 plates. (Peking.)

Institut de France: Académie des Sciences. Annuaire pour 1930. Pp. 390. (Paris: Gauthier-Villers et Cie.)

University of Illinois Engineering Experiment Station. Circular No. 18: The Construction, Rehabilitation and Maintenance of Gravel Roads suitable for Modern Traffic. By Prof. Carroll C. Wiley. Pp. 57. 30 cents. Circular No. 19: Equipment for Gas-Liquid Reactions. By Prof. Donald B. Keyes. Pp. 14. 10 cents. (Urbana, Ill.)

United States Department of Commerce: Bureau of Standards. Research Paper No. 112: Optical Heterogeneity of a Fused Quartz Disk. By L. W. Tilton and A. Q. Tool. Pp. 619-628. 5 cents. Research Paper No. 113: Data on Ultra-Violet Solar Radiation and the Solarization of Window Materials. By W. W. Coblentz and R. Stair. Pp. 629-689. 15 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES, ETC.

The Nickel Bulletin. Vol. 3, No. 1, January. Pp. 40. (London: The Mond Nickel Co., Ltd.)

Illustrated Catalogue of the Will Day Historical Collection of Cinematograph and Moving Picture Equipment, for Sale by Tender. Pp. 56+24 plates. (London: Harris and Gillow.)

Catalogue of Scientific Journals and Transactions of Learned Societies; a Selected List of Books on Travel, Topography, Ethnology, Anthropology and kindred Subjects; Books on Economics, Statistical Literature and Business, etc. (N.S. No. 2.) Pp. 82. (London: Wm. Dawson and Sons, Ltd.)

Calendar for 1930. (London: Express Letter Service.)

Eastman Organic Chemicals. List No. 21, January. Pp. 95. (Rochester, N.Y.: Eastman Kodak Co.)

Diary of Societies.

FRIDAY, FEBRUARY 14.

GENETICAL SOCIETY (at John Innes Horticultural Institution, Merton), at 2.30.—Experiments on *Primula Sinensis*:—Miss de Winton and J. B. S. Haldane: Demonstration of the Genetics of Diploid and Tetraploid Forms.—Dr. C. D. Darlington: Exhibition of Cytological Preparations of the Tetraploid.—Dr. F. W. Sansome: Exhibition of Slides Illustrating Pollen Behaviour in the Tetraploid.—J. B. S. Haldane: The Genetics of the Tetraploid.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—E. W. Hey Groves: The Hunterian Oration.

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting), at 5.—President's Address on the Award of the Gold Medal to Dr. J. S. Plaskett, for his Valuable Observations of Stellar Radial Velocities and the Important Conclusions derived from them.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—W. E. Summerhays: The Diffusion Constant of Water Vapour.—M. C. Johnson: A Method of Calculating the Numerical Equation of State for Helium below 6° Absolute, and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces.—F. D. Smith: The Magnetostriction Constant for Alternating Magnetic Fields.—Demonstration by D. Kempson of A Working Model Illustrating the Mosaic Theory of the Compound Eye, due to Altenburg.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—Prof. A. F. C. Pollard: Optical Aids to Engineering Inspection.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (Annual Meeting) (at Linnean Society of London), at 6.—H. Watson: (*a*) On the Anatomy and Affinities of *Plicatula*; (*b*) On the Central Nervous System of *Spondylus*.—J. R. le B. Tomlin: Some Preoccupied Generic Names. II.—Dr. F. A. Schilder: Remarks on Type Specimens of some Recent *Cypræidæ*.—Exhibit: *Cypræa—Arabica* Group. Eggs and Spawn of Terrestrial Mollusca.

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at 36 George Street, Manchester), at 7.—K. W. Willans: Water-tube Boilers Suitable for Locomotives.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—G. S. Taylor: Lantern Lecture.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—R. G. Daniels: Common Sense and Nitrocellulose Lacquer.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.15.—E. A. Rudge: Timber as a Material of Construction.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—L. H. Pomeroy: The Double-six Engine.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—Technical Film—The Manufacture of Staybrite and Stainless Steels.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—S. Matthews: Recent Developments in Measuring Instruments

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.—F. Moore: Unusual Coloration of Sclerotics.—R. Pickard: The Red Field and Optic Disc Resistance in Glaucoma and Allied Conditions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. A. F. Pollard: History *à la Mode*.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Flight-Lieut. H. R. W. Waghorn: The Schneider Trophy Contest of 1929.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. G. Cooke: Tonality and Expression in Song-Writing.

MONDAY, FEBRUARY 17.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Brig.-Genl. H. Biddulph: The Date of Ecclesiasticus.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Prof. Carl Størmer: Do the Wireless Echoes of Long Delay come from Space Outside the Moon's Orbit?

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Lt.-Col. R. C. F. Schomberg: Climatic Conditions in the Tarim Basin.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—R. H. O. B. Robinson: The Rôle of Short Circuit Operations in the Treatment of Cholecystitis.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—M. E. Fox, W. E. Warrilow, and others: Discussion on The Nickel-Iron Battery and its Uses.—E. C. McKinnon and others: Discussion on The Lead Battery and its Uses.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 7.—W. W. S. Robertson: Strip Rolling Mills and Auxiliary Machinery.

TEXTILE INSTITUTE (London Section) (at Barrett Street Schools), at 7.—R. J. Steele: Man's Quest for Fibres.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—W. Hunter: Some Reflections on Wool and its Uses.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales—Liverpool—Centre) (at Liverpool University), at 7.30.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Prof. P. Abercrombie: The Thames Valley Preservation Scheme.
ROYAL SOCIETY OF ARTS, at 8.—A. B. Searle: Recent Improvements in Methods of Brickmaking (Cantor Lectures) (1).
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 8.—Prof. A. J. Clark: Drugs Manufactured by the Body.
MEDICAL SOCIETY OF LONDON, at 8.—Dr. J. W. Thomson-Walker: Enlarged Prostate and Prostatectomy (Lettsomian Lectures) (1).

TUESDAY, FEBRUARY 18.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: X-ray Determination of the Structure of Cellulose and Similar Substances (2).
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Prof. M. Greenwood: The Vaccination Problem.
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—H. A. Gilbert: Exhibition of Cinematograph Films of British Birds.—O. W. Richards: The British Species of Sphæroceridæ (Borboridæ, Diptera).—S. Zuckermann: A Rhesus Macaque (*Macaca mulatta*) with Carcinoma of the Mouth.—Dr. Isabella Gordon: African Fresh-water Prawns of the Species *Caridina nilotica* Roux, with Special Reference to the Nile Basin.—Dr. C. J. van der Klaauw: On the Tympanic Region of the Skull in the *Megatherium*.—Dr. J. R. Baker: The Breeding-season in British Wild Mice.
ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street), at 6.30.—W. H. Villiers: Modern Incandescent Lighting in Kinema Studios.
LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—H. R. Hewer: The Colour of Fish and how they change it.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—J. G. Wellings and C. G. Mayo: Instrument Transformers.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—F. C. Lant: Kitchen Equipment.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. W. Clark: The Formation of a Photographic Image.
INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—L. H. Pomeroy: The Double-six Engine.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—H. E. Kershaw: Cobalt Magnet Steels.

WEDNESDAY, FEBRUARY 19.

ROYAL METEOROLOGICAL SOCIETY, at 5.—C. K. M. Douglas: The Cyclonic Depressions of November 16 and 23, 1928.—Discussion on memoir by Dr. G. C. Simpson on The Distribution of Terrestrial Radiation.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—W. McAdam Eccles: Anatomy, Orthodox and Heterodox, in Relation to Surgery.
ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Institute of Marine Engineers), at 5.30.—Eng. Capt. E. C. Smith: Pioneer Ships of the Atlantic Ferry.
ROYAL AERONAUTICAL SOCIETY (at Institution of Electrical Engineers), at 6.30.—Dr. W. Georgii and Herr Stamer: Gliding.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Sir T. F. Purves: Address.
ROYAL SOCIETY OF ARTS, at 8.—Alfred Stevens: Architect, Sculptor, Painter.
FOLK-LORE SOCIETY (Annual General Meeting) (at University College), at 8.—Presidential Address.
ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. R. S. Clay and T. H. Court: Early Achromatic Microscopes by James Smith.—D. V. Daran: (*a*) Coincident Images made use of in Mycological and Bacteriological Works with Reference to Single Spore Cultures; (*b*) Reflection Magnification used for Physiological Experiments connected with Transpiration; (*c*) Note on Illuminating Objects for Microscopical Examination.
ST. PAUL'S ECCLESIOLOGICAL SOCIETY (at Royal Institute of British Architects), at 8.—H. L. Mann: Baptismal Fonts.

THURSDAY, FEBRUARY 20.

ROYAL SOCIETY, at 4.30.—*Papers probably to be read*:—A. C. Davies, Prof. F. Horton, and E. Blundell: Critical Potentials for the Excitation of Soft X-Rays from Iron.—Prof. A. V. Hill: A Thermal Method of Measuring the Vapour Pressure of an Aqueous Solution.—M. Nottage: The Passive State of Adhesion.
LINNEAN SOCIETY OF LONDON, at 5.—Symposium on Lampreys and Ostracoderms. Speakers: Sir Arthur Smith Woodward, Prof. E. S. Goodrich, Prof. D. M. S. Watson, Dr. C. Tate Regan, G. R. de Beer.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—T. A. Joyce: Architecture and the Industrial Arts of Pre-Spanish America (2).
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss Muriel A. Payne: Homeless Children.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—Discussion on Some Technical and Practical Aspects of Colour Photography.
BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7.30.—Dr. A. W. Stevenson: Testing of Textiles.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.
CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry and G. Jessop: The Properties of the Chlorides of Sulphur. Part III. Dielectric Constants. Part IV. Density and Surface Tension.—G. A. C. Gough and H. King: Trypanocidal Action and Chemical Constitution. Part IX. Aromatic Arsinic Acids Containing an Amide Group.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Dr. V. B. Wigglesworth: Some Notes on the Physiology of Insects related to Human Disease.
BRITISH INSTITUTE OF RADIOLOGY, at 8.30.—Dr. A. E. Barclay: Mechanism of Swallowing.—Dr. J. P. Maxwell: Osteomalacia and Fœtal Rickets.—Dr. J. Muir: The Irritable Colon.
ROYAL AERONAUTICAL SOCIETY (Coventry Branch) (at Coventry).—Flight-Lieut. H. R. W. Waghorn: The Schneider Trophy Contest of 1929.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—Squadron-Leader J. J. Breen: The Westland Wapiti in Iraq.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Newport).—D. Griffiths: Tinplate Industry.

FRIDAY, FEBRUARY 21.

TEXTILE INSTITUTE (Lancashire Section) (at Textile Institute, Manchester), at 1.15.—J. Smeaton: Textile Specifications and their Preparation.
ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Lecture Room, Imperial College of Science and Technology), at 2.30.—Dr. W. R. Thompson: Biological Control of Injurious Insects and Weeds.
GEOLOGICAL SOCIETY OF LONDON (Annual General Meeting), at 3.—Presidential Address.
MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at 11 Chandos Street, W.1), at 5.—Dr. G. E. Friend: Some Notes on the Value of Clinical, Dietetic, and Physical Records in Public Schools (Presidential Address).
ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. J. B. Burt and others: Discussion on Bath Reaction in Spa Treatment.
BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5.—Radiology in Gastrointestinal Diseases.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—E. R. Flint: The Association between Gall Bladder Lesions and Hepatitis in the Human Subject.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester Section) (at Liverpool University), at 6.—J. Twomey: Flour Milling.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Rear-Admiral W. Scott Hill: Powdered Coal for Ship-Propulsion.
INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6.—Annual Report; Discussion on Sixth Report of the Steam-Nozzles Research Committee.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—S. H. Hart: Paper-insulated Power Cables.
TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—F. L. Goodall: Diagnosis of Colour Faults in Finished Goods.
BEDSON CLUB (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—Sir James Walker: Kolbe's Electrosynthesis (Bedson Lecture).
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—R. H. Lawton: Pictorial Essentials.
GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Blackburn Technical College), at 7.—Miss E. J. Wooff: A Visit to East Sutherland.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. P. S. Gardner: The Application of Electric Welding to the Erection and Strengthening of Steel Structures.
ROYAL SOCIETY OF MEDICINE (Obstetrics and Electro-Therapeutics Section), at 8.—Special Discussion on The Position of Radium in Treatment of Gynæcological Conditions. Openers: M. Donaldson and S. Dodd, Obstetrics; Dr. A. E. H. Pinch and Dr. J. E. A. Lynham, Electro-Therapeutics.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. B. S. Haldane: Principles of Plant Breeding
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Prof. McSwiney: The Problem of the Fastness of Dyes to Perspiration.

SATURDAY, FEBRUARY 22.

GEOLOGISTS' ASSOCIATION (in Natural History Museum, South Kensington), at 2.30.—Dr. W. D. Lang: Demonstration of Palæontology and the Public.
NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.
ESSEX FIELD CLUB (at West Ham Municipal College), at 3.—Celebration of 50th Anniversary.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Rothenstein: Nineteenth Century Painting in France and England (1).
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Exhibition Meeting.

PUBLIC LECTURES.

SATURDAY, FEBRUARY 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Tell-tale Inks.

MONDAY, FEBRUARY 17.

UNIVERSITY OF LEEDS, at 8.30.—S. C. Kaines Smith: Aspects of Italian Painting. (Succeeding Lectures on Feb. 24 and Mar. 3.)

TUESDAY, FEBRUARY 18.

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Feb. 19, 20, and 21.)

WEDNESDAY, FEBRUARY 19.

BELFAST MUSEUM, at 8.—Miss W. J. Sayers: The Dispersal of Seeds.

FRIDAY, FEBRUARY 21.

KING'S COLLEGE, at 5.30—Sir Rennell Rodd: Survivals of Ancient Myth in Modern Greek Folk-lore.
SURVEYORS' INSTITUTION, at 5.30.—R. A. Watson Watt: What is wrong with Wireless? (Lecture in connexion with Institution of Professional Civil Servants.)

SATURDAY, FEBRUARY 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Sanctuary in the Middle Ages.