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Industrial Economics

UNTIL 1914, the industries of Great Britain progressed more or less on an even path, developing on conservative lines and only slowly adopting the inventions resulting from scientific research. The clash of peoples in the War had a violent repercussion on industry: throughout the War, production was pressed to the utmost, there was a free interchange of information, and scientific invention was applied in a hitherto unprecedented manner. Post-War trade has experienced first a boom in 1919–20, then a slump lasting until 1925, followed by another and greater boom lasting to the end of 1929, and by an unprecedented depression from which it is beginning slowly to emerge. During all these periods, science and invention have been applied to industry as never before; there was money available during the boom periods and need for economy in production costs during the slump.

If we take stock to-day, much will be found to have changed; some of our old industries are hard hit almost beyond recovery; newer and more scientific industries have arisen which may be expected to take their place. If British industry makes the mistake of attempting to perpetuate the past, the outlook is serious, and apparently it is still foreign to the nature of those who control industry to experiment on the large scale or to act as pioneers of new and untried industries; but fortunately we are proving adept at taking up these newcomers when their teething troubles are past and they have reached the stage of being really practical as well as remunerative, which is more important from a business point of view.

Economists have preached from many texts during the depression; at times there have been as many doctrines as preachers—a fact which arises, in our belief, from insufficient knowledge of the practical details of an industry and also perhaps from the inability to grasp the problem as a whole. The factors are too numerous to fit into any one theory, their inter-play too obscure to follow easily.

Prof. Allen, in a most readable book*, has recently attempted to give a picture of the major British industries as they are at present organised. After tracing the chief features of industrial development up to 1914, indicating in particular the relative importance of the major trades in the economic life of the nation, he takes several of

* British Industries and their Organization. By Prof. G. C. Allen. Pp. xi+338. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 10*s.* 6*d.* net.

these trades in turn to describe their rise to prominence, their fortunes during the last decade and their organisation. His selection comprises the staple trades, coal, iron and steel, engineering, shipbuilding, automobiles, and cotton and woollen textiles: it could with advantage have included the chemical and the electrical industries, in which new and progressive methods predominate. He summarises the post-War history and concludes with a chapter on changes in the structure of industry. They are indeed profound, and if the man of science is to go outside his specialised subject, and help the nation at large, he must seek to study them carefully and try to understand their significance.

Instability of demand is one of the most difficult problems of modern business. Fashion has a greater and wider influence than ever before, due to the widespread circulation of the newspaper and perhaps also to cheap travel and an accelerated news service. Sir Josiah Stamp has indicated how the increased purchasing power resulting from a fall in the price of boots, due to improved methods of manufacture, may be devoted to the buying of gramophones, so setting up a new industry and providing new employment. But at any moment, the public may leave gramophones for a new interest, for example, radio, and the elaborate and costly plant and organisation built up to supply gramophones fall on evil days. In a sentence, the demand for goods and services satisfying secondary needs is less stable than is the demand for the necessities of life. It is indeed optional and erratic, as witnessed by the fact that one result of the universal adoption of the cigarette-smoking habit by our women-folk has been a diminution in their consumption of chocolates.

A like change has come over the markets for raw materials—in part due to chemical discovery—which is likely to play a continually growing part henceforth. There are enthusiasts who claim that the chemical revolution will bring lower costs, a far wider range of raw materials, a growing multitude of new products and the increasing replacement of familiar wares by superior synthetic articles. Cheaper goods, more goods, new goods, will tend to keep the wheels of industry turning, to make more work, to create new wealth, to distribute purchasing power more broadly. On the other side of the picture, these changes in the sources of raw materials will alter the relative advantages of different countries for specific manufacturing industries.

The change is inevitable, the problem of the transference of national resources to other activities must be faced: the future means more research by a greater number of workers, or perhaps, as Mr. E. W. Rice has said recently in the United States, "the time will come in industry when research will be regarded as more important than advertising". As Prof. Allen rightly emphasises, the economic system has become more rigid. Wage rates are inelastic, oncosts make up a high proportion of the total cost, mass-production technique, standardisation, rationalisation, all have had their effect. It would seem, he says, that technical factors have been given too much weight in determining the organisation of production, whilst widespread national advertising and instalment-selling have accentuated the instability of demand.

The elimination of the small firm by larger corporations with greater resources and apparently also greater bank protection, has eliminated in times of crisis what used to be termed 'healthy bankruptcy'. Output is maintained in times of stress at the bare cost of labour and materials without any contribution to overheads. Such competition is ultimately fatal, not only to the firm but also to the industry, to the nation and to the world—it is equivalent to slow decay. Such a policy is, more than any other reason, in our opinion, the cause of the present world crisis.

There have been great changes also in administrative methods—indeed a new science of industrial management is being evolved which will in time bring order out of chaos. The delegation of authority in a great business is a most important problem—the specialist is replacing the all-rounder. We find planning, employment, costing, purchasing and stores departments all entrusted with specific duties, the work of which has in turn to be co-ordinated.

Another problem is that arising out of joint stock management by experts for shareholders in substitution for that of interested owners. The disappearance of the family business has involved a loss of personal relationships with the work-people, which can only be regretted. Labour claims a greater voice in industry; much depends on the wise solution of these claims by co-partnership or some other means. Topics of this kind surveyed by Prof. Allen will well repay serious consideration by all who seek to be in touch with the most important of our national problems. We live by industry, not by politics. E. F. A.

Human Biology and Legalised Sterilisation

THE Report of the Departmental Committee on Sterilisation, which was appointed in 1932 to examine and report on the information available regarding the hereditary transmission and other causes of mental disorder and deficiency, to consider the value of sterilisation as a preventive measure, and to suggest what further inquiries might usefully be undertaken in this connexion, was issued on January 18. The Report is a most valuable summary of modern knowledge relating to an urgent social problem. It surveys the causes and extent of mental disabilities, considers the results of sterilisation, and makes important recommendations for a change in the law and practice in Great Britain. A survey of Dominion and foreign legislation relating to sterilisation is included, so that the Committee's own recommendations can be considered in the light of practice in other parts of the world.

The Committee recommends that voluntary sterilisation should be legalised in the case of a person who is mentally defective or who has suffered from mental disorder; a person who suffers from, or is believed to be a carrier of, a grave physical disability which has been shown to be transmissible; and a person who is believed to be likely to transmit mental disorder or defect. The Committee was, of course, mainly concerned with the question of sterilisation. The constitution of the Committee was such as to make it possible for the Report to include the statement that "we may perhaps be allowed to say that our recommendations are not a compromise between conflicting views adopted reluctantly in order to secure the appearance of agreement. On the contrary, we were fortunate at the end of a long enquiry in finding ourselves in complete harmony". This in itself distinguishes this Report from that recently issued by a Committee of the British Medical Association.

The Report expresses the opinion strongly that sterilisation should be voluntary, and insists on stringent medical and administrative safeguards to prevent hasty operations. It urges that the same procedure should apply for physical defects which are known to be inherited. It emphasises the point of view that sterilisation cannot replace institutional treatment, and that even if voluntary sterilisation were adopted on the largest scale, there would still be need for more and not less institutional accommodation than is at present available. Finally, the Report stresses the need for further research in several fields. It points out the striking fact that almost all State-aided research in heredity has been inspired by agricultural needs, and asks whether human heredity is not as important as that of cattle and wheat.

From the volume of adverse criticism even now appearing in the popular Press, it is to be assumed that the Committee's recommendations will meet with great opposition in Parliament and that in all probability they will not gain the support of law. It is improbable that any political party will incorporate these recommendations in its own programme, though this may happen perhaps in ten or twenty years' time. In the meantime, it must be sufficient to rejoice in the fact that it is now becoming officially recognised that man is in charge of his own destiny and that no kind of absolute authority will prevent us from tackling our own problems. The Report possesses a unique interest, for it represents the first attempt in Great Britain to apply pure biology in social practice. It is a scientific document, and its recommendations are in no way coloured by religious or political considerations. It heralds a new era in social legislation.

A Panorama of Geometry

Principles of Geometry. By Prof. H. F. Baker. Vol. 5: *Analytical Principles of the Theory of Curves.* Pp. x+247. (Cambridge: At the University Press, 1933.) 15*s.* net.

IT will be immediately admitted by all mathematicians that the foundations of pure geometry were well and truly laid by the Greeks in the period preceding and succeeding the time of Christ. They investigated in great detail the properties of the straight line, the circle and the conic sections. They had few general principles governing their researches; they were on the outlook for interesting geometrical properties wherever they could find them. On the other hand, Euclid attempted to collect all these scattered theorems and to present them in a coherent whole, studying at the same time so far as he could the underlying postulates and axioms. Nevertheless, it still remains true that the discovery of individual theorems was rather at haphazard.

It fell to Descartes (1596–1650) to devise the geometrical representation of an equation in x and y by means of abscissæ and ordinates. Thus was introduced a general method of attacking any

geometrical problem, and furthermore the notion of the 'degree' of a curve obtruded itself. It became apparent that the 'straight line' of the ancients was no more and no less than the geometrical representation of an equation of the first degree in x and y. Similarly, the conics, including the case of the circle, are merely geometrical representations of equations of the second degree in x and y.

Acting on these general ideas, Newton (1642–1727) and Maclaurin (1698–1746) attacked the curve of the third degree (usually called the cubic curve), and made substantial discoveries. It was not, however, until the middle of the nineteenth century that any progress could be made with the curve of the fourth degree. Its bitangents were discussed by Steiner (1796–1863) and Hesse (1811–1874). The properties of the plane quintic curve have been investigated during the last ten years, but practically nothing is known about the general sextic curve, though a considerable amount of research has been done on particular types of sextics.

Simultaneously with these explorations into the properties of plane curves of successive degrees, came investigations into surfaces of the first and second degrees, that is, planes and quadrics. The surface of the third degree received detailed treatment at the hands of Steiner, Sylvester (1814–1897), Salmon (1819–1904), Cayley (1821–1895) and others. Little is known about the general quartic surface, though much information has been obtained about special types. These researches into concrete curves and surfaces of the lower degrees inevitably led to speculations as to the more general characters of curves and surfaces, and particularly those possessing double points and cusps. An epoch-making discovery that transformed the whole aspect of geometry was made by Plücker (1801–1868) when he found the exact effect of the possession of double points or cusps upon the number of double tangents, points of inflexion, and tangents from a point that the general undegenerate curve possesses.

Another profound influence, though affecting pure geometry less directly than those above mentioned, underlay the discoveries of Abel (1802–1829). By his work on algebraic functions and their Abelian integrals, this young mathematician, caught off in early manhood by tragic death, in the words of Hermite "a laissé aux mathématiciens de quoi travailler pendant cent cinquante ans". The geometrical interpretation of Abel's theorems leads at once to the study of linear systems of points on a curve. The possibilities of Abel's work were extended by the work of Jacobi (1804–1851) on the theta functions and of Riemann (1826–1866) on the surfaces that bear his name. Jacobi's work on the theta functions leads immediately to the study of contact curves and surfaces. There is no textbook which will give a better idea of the general outlook in the middle of last century on geometry as affected by the development of Abel's discoveries than "Theorie der Abelschen Functionen (1866)" by Clebsch (1833–1872) and Gordan (1837–1912). This book in 333 pages develops the theory of the theta functions from first principles, avoiding all general function theory and using only the methods of relatively elementary algebra and geometry. Throughout, the book is frankly geometrical in its outlook and even in its notation. The student of the history of geometry cannot afford to neglect this work and it will well repay perusal.

The general idea of the genus of a curve soon obtruded itself from several quarters. There are p Abelian integrals of the first kind. A plane algebraic curve which has p double points or cusps less than the maximum number that it may have without degenerating has several characteristic properties. Thus a curve of genus (or 'deficiency') zero can have its co-ordinates x, y, z expressed as polynomials of a single parameter t. A curve of genus or 'deficiency' one requires the use of elliptic functions for the expression of x, y, z in terms of a single parameter U. The reduction of an n-sheeted Riemann surface to one of two sheets with p holes in it presents the same result from still another point of view.

These basic ideas gave an impetus to the study of the higher geometry in every direction. Space forbids any further preliminary discussion, but it seemed desirable to give the above rough and very incomplete sketch in order that those whose interests are not primarily geometrical should be able to form a competent view of the setting of the field, with which Prof. H. F. Baker's vol. 5 of the "Principles of Geometry" is concerned.

Prof. Baker has placed mathematicians in general and geometers in particular under a very deep obligation for his six volumes on the principles of geometry. Their design is to lay before the reader a panorama of the subject and Prof. Baker has achieved his main object extraordinarily well. Not only can the general mathematical reader obtain a deep and detailed insight into the

development of algebraic geometry, but also the professional geometer will never fail to find something new in these pages. It has been a tremendous task carried out with Tolstoyian vision.

Vol. 1 deals with "Foundations"; vol. 2 with "Plane Geometry (conics, circles, non-euclidean geometry)"; vol. 3 with "Solid Geometry (quadrics, cubic curves in space, cubic surfaces)"; vol. 4 with "Higher Geometry (being illustrations of the utility of the consideration of Higher Space, especially of four and five dimensions)"; vol. 5 with the "Analytical Principles of the Theory of Curves"; vol. 6 with an "Introduction to the Theory of Algebraic Surfaces and Higher Loci". Vol. 5 is that immediately under review. It consists of eight chapters dealt with in 247 pages. Chap. i is an introductory account of rational and elliptic curves; chap. ii deals with the elimination of the multiple points of a plane curve; chap. iii with the branches of an algebraic curve; the order of a rational function; Abel's theorem; chap. iv with the genus of a curve; fundamentals of the theory of linear series; chap. v with the periods of algebraic integrals; loops in a plane; Riemann surfaces; chap. vi with the various kinds of algebraic integrals; relations among periods; chap. vii with the modular expression of rational functions and integrals; chap. viii with enumerative properties of curves.

The general structure of vol. 5 and its place among the other volumes of Prof. Baker's series will now be clear. He deals in it with the researches of a hundred and thirty years. The book is general in character and presents by no means easy reading throughout. This is only to be expected where the subject-matter is often so essentially fundamental in character, but the author has very judiciously inserted copiously concrete examples from the case of specific curves and surfaces, and thus the reader's feet are kept on firm rock and he is not allowed to lay down the book with a notion of the treatment of vague generalities. The first part of the volume deals with linear series of curves and the sets of points they cut out on the basic curve by the methods of algebraic geometry; the second part presents much of the same subject-matter from the point of view of Abel's integrals and Abel's theorem. The theta functions and contact curves are mentioned but do not receive detailed treatment. The Riemann-Roch theorem and its consequences are expounded in great detail.

It only remains to add that vol. 5 has been printed with all the finish that one has learned to expect from the mathematical works issued by the Cambridge University Press. The treatment itself displays on every page the profundity of learning and mathematical resource that one has long associated with the name of its distinguished author. W. P. M.

Research and the Community

Ideals of a Student. By Sir Josiah Stamp. Pp. 240. (London: Ernest Benn, Ltd., 1933.) 8*s*. 6*d*. net.

SIR JOSIAH STAMP is known to all as the president of the executive of the L.M.S. Railway, and as a leading authority on the theory and practice of public finance. Apparently he has two major forms of relaxation. One is the reading of books on all possible subjects, from the Law Reports to the textual criticism of the New Testament, and from seventeenth century books on morals to the latest publications in physics, biology, economics, psychology and philosophy. The other is giving addresses to universities and educational societies, both in Great Britain and in North America, on topics appropriate to these bodies. His latest book is a synthesis of these two hobbies. It welds together in a continuous argument the themes of perhaps twenty speeches and talks delivered on various occasions during the past few years; and it contains the cream of his reflections upon his 'holiday reading', amply supported with quotations and comments.

There is in truth something Aristotelian about Sir Josiah Stamp. He has Aristotle's encyclopædic knowledge and Aristotle's philosophically matter of fact approach to the problems of life and learning. He has to a great degree Aristotle's literary style—the same series of jerky paragraphs, not always well rounded or carefully coupled with one another, the same love of appropriate, if allusive anecdote, the same readiness to put in the closest juxtaposition discussions of first principles and advice on day to day conduct—in a word, the same sturdy refusal to allow the outpourings of a well-stocked mind to be cramped by the bonds of systematic exposition. The argument of his book would have commended itself to his great predecessor. For he is concerned with the two main problems which exercised Aristotle when he wrote the *Ethics*—the problem of "theoretical wisdom", or the search for truth, and the problem of "practical wisdom", or the ways in

which knowledge can help us in the ordering of our lives.

Broadly speaking, the former subject is the theme of Chaps. iii, iv, and vii, and the latter of Chaps. i, ii, v, and vi. Chaps. iii and iv discuss the function of universities as institutions for the furthering of knowledge. They are remarkable for the understanding which they show of the special problems facing researchers in all the main fields of learning. They will be a source of encouragement to those who have feared that doctoral theses, at any rate in literature and the social sciences, are largely a waste of time.

Sir Josiah Stamp does not despise even investigations into methods of dish-washing or into the reactions of the young to the emotional stimuli of the 'movies'. He is also more sympathetic than most of us towards the desire of the writers of theses to have them published. Neither for detailed pieces of work nor for knowledge as a whole does he believe in the overriding necessity for finality; and in Chap. vii he urges that since our knowledge of the universe must be incomplete, we need not be too greatly upset if (as in physics at present) we cannot always reconcile it with itself.

On the problem of the relation of theoretical knowledge to practical problems Sir Josiah is equally helpful. In Chaps. i, ii, and vi, he examines the part that must be played by universities and schools of economics in the modern world. He sees one of the chief dangers in the present situation in the fact that so many of our political and economic problems require a greater general knowledge and (still more) a higher capacity for weighing evidence and judging impartially, than the average citizen of to-day possesses. Universities can put this right if they will both train their students in the technique of research and also provide them with an understanding of the unity of modern problems. Chap. v, "On Improving all Things", discusses one particular aspect of this subject—the relation of Christian ethics to the problems of capital versus labour, and nationalism versus internationalism. This is perhaps the only part of the book in which Sir Josiah's wide sympathies and his ability to see both sides of every question lead to his becoming ineffective, and perhaps doing less than justice to his own convictions. It is fairly clear from the rest of his work that he really believes nationalism to be a main source of our economic and political troubles. Why, then, does he not say so openly and unequivocally?

L. M. FRASER.

A Modern Flora

The Flora of Leicestershire and Rutland: a Topographical, Ecological, and Historical Account with Biographies of Former Botanists (1620–1933). By Arthur Reginald Horwood and the late Charles William Francis Noel (Lord Gainsborough). Pp. ccxcvii+687+36 plates. (London: Oxford University Press, 1933.) 35*s*. net.

THIS extensive work comprises about a thousand pages of small print. When it is taken into account that Leicestershire is a county rather poor in species, including, as the author states, only about one half of the known British species, it is clear that much of the book is taken up with matter not usually included in a flora. The bulk of this matter is in the 300 pages of introduction, which gives chapters not only on the geology, meteorology, soils, agriculture and botanical districts of the region covered, but also on the ecology of the counties, together with a very comprehensive section on the local botanical collections and investigations, with full biographies of those concerned. This is indicated by the subtitle. In all cases Rutland is dealt with separately.

What may be named the new features of the flora proper consist largely of a meticulous account of first records and the attempt to refer each species to what may be termed its ecological home. There will be many botanists, and it is to be hoped field naturalists also, who will agree with Mr. Horwood as to the importance of the geological and ecological factors in their bearing on the occurrence and distribution of the elements of a flora, but many will also feel that it is possible to overweight a flora even in these respects and particularly in matters of biography. In any event it may well be thought that the desirability of including ecology in floras is as yet something of a counsel of perfection, in view of the comparative paucity of ecologists and ecological data as compared with collectors and collections. It is greatly to be hoped that one day we may have *ecological* collections, reference to which will probably tend in time to reduce the recorded number of varieties, if not of species.

Since as a specialised study and indeed a subscience ecology belongs almost to the present century, and has arisen entirely during the fifty years since the issue of the previous "Flora of Leicestershire" in 1886, the new "Flora" reflects very well one of the great developments of botanical science which has arisen in the interval.

The authors are to be congratulated therefore on the ecological atmosphere with which they have infused the book. They might perhaps also—in view of the generous plan of the work—have included some remarks on the even more important and voluminous edifice built up by the geneticists during this period and its bearing on hybrid species. Seventy-two hybrids are reported in the summary furnished by Mr. Wade.

The change in the flora itself during the fifty years is shown by the enumeration of 50 species which have become extinct and of others erroneously recorded; on the other hand, one may quote *Pyrola minor*, discovered in 1913, as one of the additions.

The 1933 "Flora of Leicestershire and Rutland" is undoubtedly a splendid work of reference, adorned with excellent maps and photographs, incorporating as it does much more scientific information than one had any right to expect of a flora, but possibly a precursor of a new type. Nevertheless its issue in two volumes would probably have added to its usefulness.

The Committee which has remained in being for twenty years (1912–1933) is to be congratulated on its tenacity and generosity in finally overcoming all difficulties, and, through the labours of Mr. Horwood, bringing its work to a successful conclusion. E. N. M. T.

Short Reviews

Hydraulics. By Prof. Horace W. King and Prof. Chester O. Wisler. Third edition, revised. Pp. xii+292. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 16*s.* 6*d.* net.

It is a significant instance of the mutability of word meanings that the term hydraulics, which a generation or more ago was limited to the practical applications of the science of hydrodynamics, distinct alike from that subject in its theoretical aspect (that is, neglecting viscosity) and from hydrostatics, is now very commonly used to denote the whole field of hydromechanics. In an authoritative article by the late Prof. Unwin, in the ninth (1881) edition of the "Encyclopædia Britannica" the distinction just given is clearly drawn. On the other hand, in the text-book under notice, as also in other cases, the writers treat hydraulics as an omnibus subject comprising the three divisions of hydrostatics, hydrokinetics and hydrodynamics.

It is obvious, of course, that no satisfactory knowledge of the behaviour of water in motion can be acquired without some fundamental acquaintance with its characteristics when at rest, but this is not quite the same thing as making hydraulics a compendium of the physics of water. One disadvantage which presents itself is that the field becomes too wide for effective treatment in brief compass, and the writers of the present exposition cannot claim to have covered the whole of the ground in the book of less than 300 pages.

About one-sixth of the work is devoted to hydrostatics, and roughly the same amount to theoretical hydrokinetics and hydrodynamics. The remainder relates to hydraulics in the old sense of the word, and provides a consideration of flow through orifices and tubes, over weirs and dams and in pipes and open channels, including both uniform and non-uniform flow, the latter being a subject of some novelty in textbooks. The present issue is the third edition, so that the book has attained a satisfactory measure of acceptance, which is justified by the clarity of treatment, both in regard to the text and the diagrams. Students will undoubtedly find it useful as an introductory survey of the subject, more particularly on the theoretical side. Each chapter has appended a number of problems to which the answers are given. B. C.

Riddles of the Gobi Desert. By Sven Hedin. Translated from the Swedish by Elizabeth Sprigge and Claude Napier. Pp. x+382+24 plates. (London: George Routledge and Sons, Ltd., 1933.) 18*s.* net.

In this volume, the narrative of the Sino-Swedish expedition to the Gobi Desert, which was at work continuously from 1927 until 1933, carries the story on for a further period of two years. It resumes with the author's return journey to Sinkiang from Sweden in 1928, and closes with reports covering the work of exploration up to the end of 1929. As the author was busily engaged in the administrative work of the expedition in China, and was further distracted by a journey to the United States, which was extended to Sweden, on account of his health, he was unable to take the field in person; and his detail is necessarily drawn from the reports of his colleagues. His narrative is none the less absorbing and, when he is dealing with the incidents of his own journeys, is vivid in its sketches of persons and events.

The closing chapters of the book embody the individual reports of members of the expedition on the different departments of investigation, meteorology, palæontology, geography, archæology, etc. Although of a preliminary character only, they are sufficiently full to indicate the importance of the material obtained. Further detail, especially that

relating to the neolithic civilisation of the desert and the painted pottery resembling that from Honan, will be awaited with interest. A chapter added after the publication of the Swedish edition of the book records the discovery of the new Lop Nor in 1931.

Much of the narrative is occupied with the difficulties encountered by the expedition in its relations with Chinese provincial officials. At Peking and Nanking, all, from President downward, were most cordial and the whole learned and official world co-operated to promote the success of the expedition in every way.

(1) *Intelligence and Intelligence Tests.* By Rex Knight. (Methuen's Monographs on Philosophy and Psychology.) Pp. ix+98. (London: Methuen and Co., Ltd., 1933.) 2*s.* 6*d.* net.

(2) *Psychology and the Choice of a Career.* By Dr. F. M. Earle. (Methuen's Monographs on Philosophy and Psychology.) Pp. vii+103. (London: Methuen and Co., Ltd., 1933.) 2*s.* 6*d.* net.

THE purpose of the series of monographs to which these two books belong is the entirely commendable one of setting forth, for the benefit of the general reader, and with a practical end in view, the results of some of the best recent work in the fields of psychology and philosophy. This purpose is well achieved in both of these two members of the series. In each case the problem is a very practical one, and in each case the author manages to show, simply but without any sacrifice of accuracy, how scientific method is contributing towards its solution.

(1) Mr. Rex Knight gives a clear and concise account of intelligence tests, and of their use in diagnosing mental deficiency, in the grading of pupils, in the study of difficult children, and in vocational guidance and selection.

(2) In Dr. Earle's book the general principles of vocational guidance, so far as they have yet been discovered, are systematically stated. In such guidance, as the author shows, not only the psychologist, but also the parent, the doctor, the teacher, and the employment officer, each has a part to play.

Both these introductory manuals are fittingly equipped with brief but sufficient advice as to further reading.

Textile Electrification: a Treatise on the Application of Electricity in Textile Factories. By Dr. Wilhelm Stiel. Authorized translation by A. F. Rodger. Pp. xix+608+6 plates. (London: George Routledge and Sons, Ltd., 1933.) 63*s.* net.

THE textile industry has probably gone further than any other industry in replacing handicraft by machine production. The transition took place in the first half of the nineteenth century concurrently with the introduction of steam power. This led inevitably to displacing the cottage industry (spinning wheel and hand-loom) by large mills. So successful was the use of steam power and line shaft driving that manufacturers were loath to change to electric power and individual drive. In the development of individual driving by electric motors, Germany has played the leading part. This has opened up new prospects for small textile undertakings. It looks as if it might revive the cottage industry. As the English-speaking countries possess more than half the world's cotton spindles, the importance of spinning and weaving to Great Britain justifies the translation of this standard work into English. The book is thoroughly practical and can be warmly recommended to everyone connected with the textile industry.

Our Forefathers, the Gothonic Nations: a Manual of the Ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian Peoples. By Dr. Gudmund Schütte. Vol. 2. Pp. xvi+483+20 plates. (Cambridge: At the University Press, 1933.) 30*s.* net.

IN the second volume of "Our Forefathers", Prof. Schütte, having already in his first volume disposed of general questions relating to the Indo-Germanic peoples, passes on to deal with individual 'Gothonic' groups. Each is taken in turn and its early history reviewed in the light of the evidence of literary records, philology, place-names, tradition, archæology and ethnology. The Anglo-Saxons and the Scandinavian peoples, naturally, receive extended treatment.

Prof. Schütte has had the advantage of the assistance of specialists, but where this has been unobtainable, his own critical examination of the evidence and his suggestions in dealing with controversial points are both acute and stimulating. His book will be invaluable for reference purposes in the study of the early history of the European peoples, pending the production of the detailed ethnology to which he regards his own work as merely preliminary.

Phytopathological and Botanical Research Methods. By Prof. T. E. Rawlins. Pp. ix+156. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 15*s.* 6*d.* net.

THE rapid development of plant pathological investigations, and the increasing use of microchemical methods, have created a need for a survey of the various microscopic and culture methods adopted by workers in these subjects.

Considerable experimental work was done before publication, and many of the methods described are new, while others demonstrate improved technique. Though primarily intended for phytopathologists, workers in other fields should find much useful information. A short, but suggestive, chapter is given on the interpretation of experimental results, and an important section of the book is the bibliography, with nearly one thousand references covering a wide field of investigation.

Mendeléeff (1834–1907) and the Periodic Law

DMITRI IVANOWITSCH MENDELÉEFF, who was born on February 7, 1834 (N.S.) and was for many years professor of chemistry at Leningrad, is chiefly remembered for the first clear and satisfactory enunciation of the Periodic Law, the discovery having been made in the latter part of the year 1868 and announced in 1869. He found that when the chemical elements are set out in an unbroken row in the order of the atomic weights, certain breaks become apparent, and the whole range divides itself into groups of related elements. This result, expressed in the law that "the properties of the elements are in periodic dependence on the atomic weights" is the basis of the Periodic System, or Periodic Table. In arriving at this conclusion, Mendeléeff was influenced mainly by the previous attempts at classification made by Dumas, Lenssen, Pettenkofer and Kremers, especially the first two, those of Newlands in 1863, and of others, being unknown to him. A similar result had been achieved by Lothar Meyer in 1868, but was not published.

A German abstract of Mendeléeff's discovery, containing all the essential features, appeared in 1869, in which year it was thus generally known in Europe, and a long paper of 1871 gave a table which is essentially in its modern form. These publications attracted very little attention, but the interest of chemists was aroused by the discovery, in 1875 and 1879, respectively, of the elements gallium and scandium, which were found to have the properties predicted for the missing elements which Mendeléeff had called ekaaluminium and ekaboron, places for them being reserved in the table. The element germanium, discovered in 1866, was also recognised as the ekasilicon of Mendeléeff. These discoveries made it clear that the Periodic Law was a fundamental truth, and the further progress of research has emphasised more and more its supreme importance in the study of the elements.

The discovery of argon was an indication to Ramsay that a new group of elements of zero valency must be added to the table, and the elements helium, neon, krypton and xenon were before long added to the group, and the last member is the radioactive emanation. The suggestions of Mendeléeff that this group also contained two other elements, one being the ether, of very small atomic weight, and the other an unknown element of atomic weight less than 0·4, and that there was a missing element of the halogen group, of atomic weight 3, have appeared inconsistent with modern views of the structure of the atomic nucleus.

The regularities among the atomic weights of the elements as disclosed in the Periodic System could not fail to revive speculations about a primary matter, which had attracted chemists since Prout had suggested that this primary matter was hydrogen. Mendeléeff was entirely opposed to this hypothesis of primary matter. The difficulty of fractional atomic weights was removed by the discovery that many elements are mixtures of isotopes, and the investigations on atomic structure showed that the Periodic Law is a consequence of the formation of atoms from protons and electrons. This recognition of isotopes also removed the objection that some pairs of elements, such as iodine and tellurium, were apparently placed in the wrong order in the table on the basis of their atomic weights, their true positions never being in doubt. The discovery that the position of an element in the table is really conditioned by its atomic number, or the positive charge on the atomic nucleus, gave the Periodic Law a fundamental character, and the theory of atomic disintegration enabled all the newly discovered radioactive elements to find their places in the lower part of the table, in many cases a single place containing several isotopes of the same atomic number.

An outstanding difficulty was the position of the elements of the rare earths. After lanthanum and cerium came a large number, not definitely known, of elements of very closely related properties, clearly belonging to the same group. After these came the element tantalum, obviously in the fifth group. For many years the rare earth element cerium, which forms very stable compounds in which it is quadrivalent, was considered to be the fourth group element of the rare earths. This difficulty was overcome on the basis of the theory of atomic structure by Bohr. The pronounced tervalent character of the rare earth elements, preserved with steadily increasing atomic weight, was shown to be a consequence of the presence in their atoms of incompleted inner electron levels, the filling up of which, by successive additions of electrons to keep step with the increasing nuclear charge, left unchanged the outer valency electrons. The atomic numbers of the rare earths were also determined by X-ray spectroscopy, and a knowledge of these, together with the information on the numbers of electrons in completed groups which resulted from general atomic theory, showed that an unknown element of the fourth group must come before tantalum. This element was shortly afterwards discovered in hafnium. There was also, it was clear, an earlier unknown element in the rare earth group, which has been found in illinium. The group of rare earths was then known to be complete.

The Periodic Law has thus assisted very materially in promoting discovery and has shown itself to be a truth of great extension and depth. Mendeléeff himself said: "I have never once doubted the universality of this law, because it could not possibly be the result of chance." It is, in fact, the great guiding principle in the study of the structure of the atom.

The Ether-Drift Experiment and the Determination of the Absolute Motion of the Earth*

By PROF. DAYTON C. MILLER, Case School of Applied Science, Cleveland, Ohio

THE ether-drift experiment first suggested by Maxwell in 1878 and made possible by Michelson's invention of the interferometer in 1881, though suitable for the detection of the general absolute motion of the earth, was actually applied for detecting only the known orbital component of the earth's motion. For the first time, in 1925 and 1926, I made observations at Mount Wilson of such extent and completeness that they were sufficient for the determination of the absolute motion of the earth. These observations involved the making of about 200,000 single readings of the position of the interference fringes.

The ether-drift observable in the interferometer, as is well known, is a second order effect ; and the observations correctly define the line in which the absolute motion takes place, but they do not determine whether the motion in this line is positive or negative in direction.

At the Kansas City meeting of the American Association for the Advancement of Science, in December, 1925, before the completion of the Mount Wilson observations, a report was made showing that the experiment gives evidence of a cosmic motion of the solar system, directed towards a northern apex ; but the effects of the orbital motion were not found, though it seemed that the observations should have been quite sufficient for this purpose[1].

The studies of the proper motions and of the motions in the line of sight of the stars in our galaxy have shown that the solar system is moving, *with respect to our own cluster*, in the general direction of a northern apex in the constellation Hercules. This apex is near that indicated by the ether-drift observations as just reported, and seemed to be confirmatory evidence of its correctness. Probably it was this that caused the continuation of the analysis of the problem, on the supposition that the absolute motion was to the northward in the indicated line. All possible combinations and adjustments failed to reconcile the computed effects of combined orbital and cosmic motions with the observed facts.

In the autumn of 1932, a re-analysis of the problem was made, based upon the alternative possibility that the motion of the solar system is in the cosmic line previously determined, but is in the opposite direction, being directed southward. This gives wholly consistent results, leading for the first time to a definite quantitative determination of the absolute motion of the solar system, and also to a positive detection of the effect of the motion of the earth in its orbit.

The absolute motion of the earth may be presumed to be the resultant of two independent component motions. One of these is the orbital motion around the sun, which is known both as to magnitude and direction. For the purposes of this study, the velocity of the orbital motion is taken as 30 kilometres per second, and the direction changes continuously through the year, at all times being tangential to the orbit. The second component is the cosmical motion of the sun and the solar system. Presumably this is constant in both direction and magnitude, but neither the direction nor magnitude is known ; the determination of these quantities is the particular object of this experiment. The rotation of the earth on its axis produces a velocity of less than four tenths of a kilometre per second in the latitude of observation and is negligible so far as the velocity of absolute motion is concerned ; but this rotation has an important effect upon the apparent direction of the motion and is an essential factor in the solution of the problem. Since the orbital component is continually changing in direction, the general solution is difficult ; but by observing the resultant motion when the earth is in different parts of its orbit, a solution by trial is practicable. For this purpose it is necessary to determine the *variations* in the magnitude and in the direction of the ether-drift effect throughout a period of twenty-four hours and at three or more epochs of the year. The observations made at Mount Wilson correspond to the epochs April 1, August 1 and September 15, 1925, and February 8, 1926.

The point on the celestial sphere towards which the earth is moving because of its absolute motion is called the apex of its motion. This point is defined by its right ascension and declination, as is a star, and the formulæ of practical astronomy are directly applicable to its determination from the interferometer observations. The theoretical consideration of the determination of the apex of the motion of the earth has been given in a paper by Prof. J. J. Nassau and Prof. P. M. Morse[2].

Table 1 gives the right ascensions and declinations of the apexes of the earth's cosmical motion as obtained from the interferometer observations for the four epochs on the presumption of a southward motion, together with the right ascensions and declinations calculated upon the theory of an ether-drift.

Table I. Location of resultant apexes

Epoch	α (Obs.)	α (Calc.)	δ (Obs.)	δ (Calc.)
Feb. 8	$6^h\ 0^m$	$5^h\ 40^m$	$-77°\ 27'$	$-78°\ 25'$
April 1	3 42	4 0	76 48	77 50
Aug. 1	3 57	4 10	64 47	63 30
Sept. 15	5 5	5 0	62 4	62 15

Apex of cosmic component $\alpha = 4^h\ 56^m$, $\delta = -70°\ 33'$

From these resultant apexes are determined four

* Paper read before Section A (Mathematical and Physical Sciences) of the British Association meeting at Leicester on September 13 ,1933.

values for the apex of the cosmic component, which is the apex of the motion of the solar system as a whole. This apex has the right ascension $4^h\ 56^m$ and the declination 70° 33′ south.

Continuing the astronomical description, having found the elements of the 'aberration orbit', these are used to compute the apparent places of the resultant apexes for the four epochs of observation. On the accompanying chart of the south circumpolar region of the celestial sphere (Fig. 1), the large star indicates the apex of the cosmic motion, and the four circles show the locations of the calculated apexes. These apexes necessarily lie on the closed curve representing the calculated aberration orbit, the centre of which is the apex of the cosmic component of the earth's motion. This aberration orbit is the projection of the earth's orbit on the celestial sphere, which in this case is approximately a circle. The observed apexes for the four epochs are represented by the small stars. The locations of the pole of the ecliptic and of the star Canopus are also shown. The close agreement between the calculated and observed apparent apexes would seem to be conclusive evidence of the validity of the solution of the ether-drift observations for the absolute motion of the earth and also for the effect of the orbital motion of the earth, which hitherto has not been demonstrated.

It may seem surprising that such close agreement between observed and calculated places can be obtained from observations of such minute effects, and effects which are reputed to be of such difficulty and uncertainty. Perhaps an explanation is the fact that the star representing the final result for the February epoch is, in effect, the average of 8,080 single determinations of its location; the star for the August epoch represents 7,680 single determinations, that for September, 6,640, and that for April, 3,208 determinations.

The location of the apex of the solar motion is in the southern constellation Dorado, the Sword-Fish, and is about 20° south of the star Canopus, the second brightest star in the heavens. It is in the midst of the famous Great Magellanic Cloud of stars. The apex is about 7° from the pole of the ecliptic and only 6° from the pole of the invariable plane of the solar system; thus the indicated motion of the solar system is almost perpendicular to the invariable plane. This suggests that the solar system might be thought of as a dynamic disc which is being pulled through a resisting medium and therefore sets itself perpendicular to the line of motion.

It is presumed that the earth's motion in space is projected on to the plane of the interferometer, and the *direction* of this motion is determined by observing the variations produced in the projected component by the rotation of the earth on its axis and by the revolution around the sun. Both the magnitude and the direction of the observed effect vary in the manner and in the proportion required by an ether-drift, on the assumption of a stagnant ether which is undisturbed by the motion of the earth through it. But the observed *magnitude* of the effect has always been less than was to be expected, indicating a reduced velocity of relative motion, as though the ether through which the interferometer is being carried by the earth's motion were not absolutely at rest. The orbital

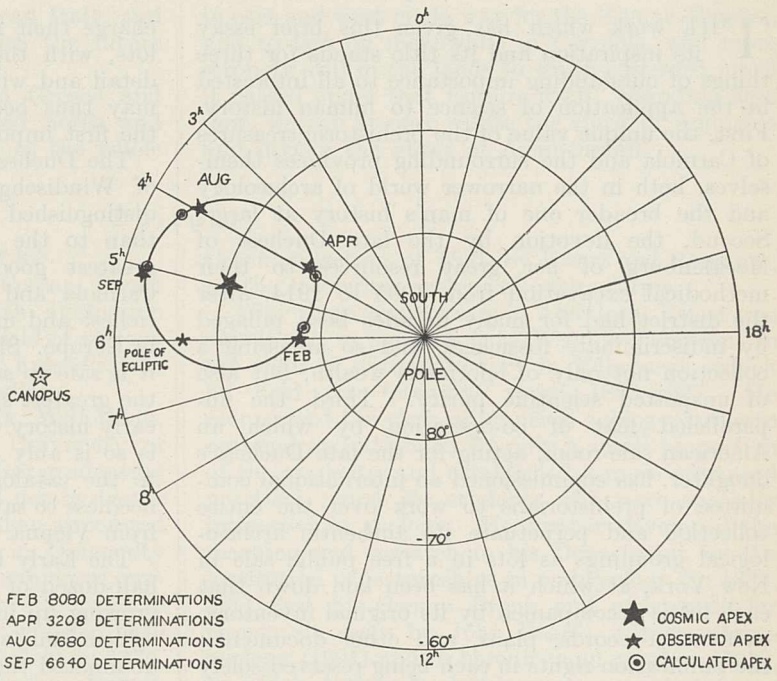

FIG. 1. Observed and calculated apexes of the absolute motion of the solar system.

velocity of the earth being known, 30 kilometres per second, the cosmical velocity of the solar system, determined from the proportional variations in the observed effects, is found to be 208 kilometres per second.

Table II gives the observed periodic displacement of the fringe system as the interferometer rotates on its axis, and the corresponding velocity of relative motion of the earth and ether.

Table II. Displacements and velocities

Epoch	Fringe Shift	Velocity (Obs.)	Velocity (Calc.)
Feb. 8	0·104 l	9·3 km./sec.	195·2 km./sec.
April 1	0·123	10·1	198·2
Aug. 1	0·152	11·2	211·5
Sept. 15	0·110	9·6	207·5

The last column gives the velocity to be expected in the stagnant ether theory on the presumption

that the cosmic component and the orbital component are both reduced in the same proportion in the interferometer. The mean factor of reduction is $k=0{\cdot}0514$. The azimuth of the observed effect is subject to a diurnal variation, produced by the rotation of the earth on its axis. The observed oscillations of the azimuth are in accordance with theory as to magnitude and time of occurrence, but for some unexplained reason, the axis of the oscillations is displaced from the meridian. In order to account for the results here presented, it seems necessary to accept the reality of a modified Lorentz-FitzGerald contraction, or to postulate a viscous or dragged ether as proposed by Stokes.

The results here reported are, notwithstanding a common belief to the contrary, fully in accordance with the original observations of Michelson and Morley of 1887, and with those of Morley and Miller of 1904–5. The history of the ether-drift experiment and a description of the method of using the interferometer, together with a full account of the observations and their reduction, has been published elsewhere[3].

[1] *Science*, **63**, 433; 1926. NATURE, **116**, 49; 1925.
[2] *Astrophys. J.*, March, 1927.
[3] *Rev. Mod. Phys.*, **5**, 203, July, 1933.

Treasures of Carniola*

By CHRISTOPHER HAWKES, British Museum

THE work which has given this brief essay its inspiration and its title stands for three things of outstanding importance to all interested in the application of science to human history. First, the unique value of the prehistoric treasures of Carniola and the surrounding provinces themselves, both in the narrower world of archæology and the broader one of man's history at large. Second, the devotion by the late Duchess of Mecklenburg of her great resources to their methodical excavation from 1905 to 1914, after the district had for many decades been pillaged by indiscriminate fossickers, and so amassing a collection not only of enormous wealth, but also of unspotted scientific purity. Third, the unparalleled feat of co-operation by which an American sale-room, acting for the late Duchess's daughter, has commissioned an international committee of prehistorians to work over the entire collection and perpetuate its authentic archæological groupings as lots in a free public sale in New York, at which it has been laid down that each lot is accompanied by its original inventory, excavation-records, plans, and other documents, the publication rights in each being reserved solely to its purchasers. The volume now before us is the catalogue which embodies the archæological committee's work, and in enabling its publication the American Art Association Anderson Galleries have caused an outstanding contribution to be made to prehistoric science.

The sale took place on January 26, and its results are still unknown to us. It is evident that much of the collection will never re-cross the Atlantic, and it is known that of the European countries whose national museums may be enriched by shares, Great Britain has decided not to be one. But it is to be hoped that the purchasers, whatever their nationalities, will faithfully discharge their manifest obligation to publish their lots, with their documentation behind them, in detail and without delay. The Mecklenburg sale may thus become an international precedent of the first importance in many scientific spheres.

The Duchess of Mecklenburg was born Princess of Windischgrätz, and came of a family long distinguished for services to archæology no less than to the Austro-Hungarian crown. By the greatest good fortune, their oldest estates in Carniola and Styria coincided with one of the richest and most important archæological centres in Europe. She deserved well of her heritage. For it is safe to say that her excavations form one of the greatest single contributions ever made to the early history of man in this Continent. How this is so is ably expounded in the long introduction to the catalogue by Dr. Adolf Mahr, who, it is needless to say, went to his present post in Dublin from Vienna.

The Early Bronze Age saw the birth of a round half-dozen of great cultural groupings in Europe, growing up in the earlier centuries of the second millennium B.C. Of these, Minoan civilisation dominated the Ægean from Crete. Italy received a Bronze Age culture linked through the Alpine lakes with the barrow-builders of west-central Europe; and north and east of these three a civilisation of many provinces but a single broadly-conceived character stretched from the Balkan and Dinaric mountains to Saxony and Silesia. Equilibrium at last grew into tension, and rather before 1000 B.C. the tension snapped. The aspect of Europe was in a short time transformed. The Minoan-Mycenæan civilisation crumbled to its downfall, accompanying upheaval in the Near East and all over south-eastern Europe. The Etruscans thereafter left Asia Minor for Italy, to lay the foundations of its future; while from the great East European culture-area beyond the mountains migrating tribes had come pouring out, pressing into the Balkan highlands, and down to the Ægean, debouching on to the head of the Adriatic, penetrating the Swiss and south German plains and valleys, and absorbing their peoples in a varied but essential continuum reaching to

* Treasures of Carniola: Prehistoric Grave Material from Carniola Excavated in 1905–14 by H.H. the late Duchess Paul Friedrich of Mecklenburg (*née* Princess Marie of Windischgrätz). Sold by Order of her Daughter, H.H. the Duchess Marie Antoinette of Mecklenburg. Catalogue compiled under the direction of Dr. Adolf Mahr (Dublin), assisted by Prof. Raymond Lantier (St. Germain), Dr. Gero von Merhart (Marburg a.d.L.), Mr. J. M. de Navarro (Cambridge), Prof. Balduin Saria (Ljubljana), Prof. Ferenc de Tompa (Budapest), Dr. Emil Vogt (Zurich) and others. Pp. x+131+33 plates. (New York: American Art Association, 1934.)

France and the British Isles. Meanwhile, from the south-east or east, there came into Europe the knowledge of iron.

The Early Iron Age that followed is the dawn of European history. The culture with which these great movements led it to open is round the Ægean called the Geometric, in Italy the Villanovan and Etruscan, and northwards of these the Hallstatt culture, from the great cemetery site in Upper Austria where it was first recognised, and where the Duchess of Mecklenburg in her turn came to excavate. East of the central Alps, the peoples of the Hallstatt culture were predominantly Illyrians. These Illyrians lay open to the east whence were coming the Scyths, they stretched down the Balkan Peninsula to the confines of Greece, they marched beyond the head of the Adriatic with Villanovan and Etruscan Italy, and to the north-west they mingled with the future Celts.

Carniola, where the routes from Greece and Italy meet, with the ways east and north and west lying open behind, is the key to the whole great nexus. Here, in cemetery after cemetery of surpassing richness, we can trace the development and appraise the character of the Hallstatt civilisation as never before, in the Duchess's great collection. It would be impossible to go into details here: the total number of excavated graves is estimated at more than 1,300, and a reckoning of 20,000 individual objects may be short of the truth. But if this mass of material, scientifically interpreted, helps us to understand the Hallstatt civilisation at its focal point, it opens our eyes to the unity of a great stretch of human history. For, linked as it was to Etruscan Italy and Geometric Greece, with the shadow of the old Mycenæan Empire behind them, the Hallstatt civilisation was spread out over barbarian Europe, to give birth to that of the Celts whose conquests in east and west made way for the Roman Empire, and to last on meanwhile in Carniola, and more strongly still in the lands to south-eastward, until it passed under that Empire itself. Standing here now, we can at once salute the spirit of Augustus and invoke the ghost of Agamemnon.

Obituary

Prof. J. Cossar Ewart, F.R.S.

THE death of Prof. James Cossar Ewart removes one who worked with distinction for more than half a century in the field of zoology and was a pioneer in the study of hybridisation and other problems of animal breeding.

Prof. Ewart was born at Penycuik, Midlothian, in 1851 and in 1871 entered the University of Edinburgh as a medical student. After graduating in 1874 he acted for six months as demonstrator of anatomy under Turner and was then appointed curator of the Zoological Museum in University College, London. Besides adding numerous preparations both of vertebrates and invertebrates to the collection, he assisted Lankester, who had been appointed professor in University College in 1874, to organise the first course of practical zoology in the College, and in the absence of his chief in the summer of 1878 he was in charge of this class. During this period Ewart published papers on the structure of the lens and retina, on points in the anatomy of the lamprey and on the life-history of lower organisms, including *Bacillus anthracis*, and for this last work, presented as a thesis for the degree of M.D. (Edin.), he was awarded a gold medal.

At the end of the summer term of 1878 Ewart returned to Edinburgh and became a lecturer in anatomy in the extra-mural School of Medicine, but after about two months in this office he was appointed professor of natural history in the University of Aberdeen and began his work there in January 1879. In the same year he established a small marine zoological station near Aberdeen—the first marine laboratory in Britain—in which he and others conducted investigations during the next three years. The most notable product of the station was the material for the Croonian lecture of 1881, by Ewart and Romanes, on the locomotor system of echinoderms.

After three active years in Aberdeen, Ewart was appointed, in succession to Wyville Thomson, to the chair of natural history in Edinburgh, which he held for forty-five years—1882–1927. He reorganised the class of practical zoology, hitherto optional and attended by only a small proportion of the students, and established a more advanced practical course for students who were specially interested in zoology. He further developed the teaching and research in his Department by the institution of lectureships in embryology (in 1885, held first by George Brook and afterwards for twenty-six years by John Beard), in invertebrate zoology (1901) and in heredity and genetics (1910, to which Arthur Darbishire was appointed).

In 1882 Ewart became scientific member of the Fishery Board for Scotland, and during the next seven years was the author or joint author of about a dozen papers and reports on fisheries subjects including the natural history of the herring. Then followed the series of well-known papers, from 1888 until 1895, on the electric organ of the skate (*Raia*) and on the cranial nerves and lateral sense organs of this fish and *Lœmargus*. He showed that the electric organ of the skate, discovered by Dr. James Stark of Edinburgh in 1844, was a developing and not a degenerating structure, and that in its most primitive condition, as seen in *Raia radiata*, the muscle fibres from which the electric elements are formed are less modified than in other species, and that in *Raia batis* the modification has proceeded so far that the adult electric organ presents little trace of its relation to muscular tissue.

Ewart's investigations on the cranial nerves were undertaken at a time of considerable activity in

neurological research and "trusting mainly to the old methods of the comparative anatomist" he gave an accurate account of the lateral sense organs and their nerve supply and of the macroscopic anatomy of the cranial nerves of *Lœmargus* and, with J. C. Mitchell, of *Raia*. He had further preparations made for continuing his work on the cranial nerves, but was diverted by his interests in the development of the limbs of the horse. He showed in 1894 that in fœtal horses a digit composed of three phalanges was borne on the distal end of each of the splint bones which represent the metacarpals and metatarsals of the second and fourth digits, but that about the time of birth the phalangeal joints disappear, the phalanges become ossified and, early in the second year, fuse with their respective splints forming the "buttons". This was an important and interesting contribution in view of the reduction of these digits known to have occurred in the evolution of the limbs of the horse.

About 1895 Ewart began his work in animal breeding. It is to be remembered that Mendel's laws were not rediscovered until 1900, but Ewart devised careful experiments to throw light on some of the problems of cross breeding and in-breeding, on reversion and on telegony. The best known of these investigations were those in which mares of various breeds were crossed with a Burchell's zebra stallion. Ewart thoroughly studied the hybrids and presented the results, together with those of many other breeding experiments in a volume, "The Penycuik Experiments" (1899), which attracted much attention. The zebra hybrids formed an interesting exhibit at the Royal Agricultural Society's Show in York in 1900. His investigations to test the theory of telegony—that a sire may 'infect' the dam served by him and leave his mark on her subsequent offspring by other sires—led him to a negative result, and he showed that the appearances described could be explained as examples of reversion.

Several papers followed on different subspecies of horses, and on the origin and evolution of horses and ponies, and Ewart described (1906) the animal remains, more particularly of a considerable number of horses, found in the Roman fort at Newstead near Melrose. Papers on domestic sheep and their wild ancestors marked a further development of Ewart's work, and the renting from 1913 until 1921 by the University of Edinburgh of a farm at Fairslacks enabled him to conduct investigations for the improvement of the fleece of sheep, which brought him into contact with the woollen industry in Scotland; he also became an active member of the Council of the Wool Industries Research Association in Leeds. Ewart's expert knowledge was the chief factor which decided the Board of Agriculture for Scotland to constitute in Edinburgh in 1913 a committee on animal breeding. This committee was suspended during the War but was re-established in 1919 and in 1920 appointed Dr. (now Prof.) F. A. E. Crew as director of research, under whom the work in genetics and animal breeding has developed into a separate Department of the University.

The rearing of penguins in the Zoological Park in Edinburgh afforded Ewart the opportunity to study the sequence and the structure of the different types of feathers. In a paper in 1921 he discussed the origin and history of feathers, and he continued until about two years ago to devote attention to the relationship of feathers and scales.

Ewart had skilful hands and could make a good dissection and admirable drawings; early examples of his drawings are to be found in the plates of Turner's lectures on the placenta (1876). He was elected F.R.S. in 1893, was awarded the Neill Medal and Prize of the Royal Society of Edinburgh in 1898 in recognition of his investigations on telegony, and in 1928 received the honorary degree of LL.D. from his old University. He retired from his chair in 1927 and died in Penycuik on December 31, 1933. He is survived by his widow, a married daughter and a son, who is a surgeon in London. J. H. A.

Dr. F. H. H. Guillemard

Francis Henry Hill Guillemard, whose death occurred on December 23, was born at Eltham in 1852. Travel and natural history made a strong appeal to him from boyhood onwards. At an early age he announced his intention of becoming a traveller and a doctor, and his first published work was an article on "Pigeons" in the *Boys' Weekly* in 1866. Destined for Rugby, he was kept at home between 1866 and 1868 owing to ill-health and afterwards went to a 'crammer' at Richmond. By this time he had become an habitué of Stevens' rooms in King Street, Covent Garden, never missing a natural history sale if he could help it and seeing there the great ornithologists of the day—Newton, Lilford, Howard Saunders and others. In 1870 he went up to Gonville and Caius College, Cambridge, where he read medicine under Humphry and Paget.

As an undergraduate, Guillemard made two journeys to the Orkneys, chiefly for bird study, which was one of the ruling passions of his life, and immediately after he had taken his degree he made a more ambitious trip to Lapland. At St. Bartholomew's Hospital he was clinical clerk to Patrick Black at the time when Robert Bridges was house physician.

Taking his M.B. degree in 1876, Guillemard entertained no thoughts of medical practice. Travel was his objective, and in 1877 he had the opportunity of exploring some little-known parts of Africa, trekking across the Transvaal and the Orange Free State in the old bullock-wagon manner and visiting the diamond fields in their early days. His articles on the ornithology of South Africa were published in the *Field* in 1880 and 1881, and the journey also provided the subject for his M.D. thesis, "On the Endemic

Hæmaturia of Hot Climates caused by the Presence of *Bilharzia Hæmatobia*", which was published in 1882. Guillemard's most famous journey was begun in 1881 when the *Marchesa* (schooner yacht of 420 tons, Mr. C. T. Kettlewell captain and owner) was commissioned. The *Marchesa* reached Colombo in April 1882; from there she sailed to Singapore, Formosa, the Liukiu Islands, Japan, Kamschatka, the Sulu Archipelago, North Borneo and New Guinea. From the Malay and Papuan regions the *Marchesa* brought home a large collection of natural history objects, most of them obtained in the large islands of north-west New Guinea. In particular, Guillemard was a passionate enthusiast for the birds of paradise, of which seventeen different species were found. The whole collection of birds, numbering about 3,000 specimens, was described by Guillemard in the *Proceedings of the Zoological Society* of 1885, and on his return to England he settled in Cambridge with the view of writing a complete account of his journey. "The Cruise of the *Marchesa*" was published in 1886 and was hailed as one of the best travel books in many years; such passages as that describing the first view of the Kamschatka group of volcanoes have made a permanent place for themselves in the literature of travel.

Guillemard became a member of the British Ornithological Union in 1885 and, at the suggestion of Lord Lilford, went to Cyprus to make a study of the ornithology of the island. Returning to Cambridge, he was the first holder of the lectureship in geography in the University, but owing to ill-health resigned the post almost immediately. A few years later, Guillemard settled at the Old Mill House at Trumpington, and there he lived until his death. Though he held no official post in the University, he was one of its best known figures: he was the general editor of the Cambridge Geographical Series and of the Cambridge County Geographies published by the University Press; he wrote the life of Magellan and the volume on Malaysia and the Pacific Archipelago in Stanford's "Compendium of Geography"; he was active on the Botanic Garden and Fitzwilliam Museum Syndicates. Above all, he had a wide circle of friends from whom he won affection as well as admiration. With the passing of Henry Guillemard, Cambridge loses something that was exquisite and unique.

WE regret to announce the following deaths:

Dr. D. H. Scott, F.R.S., honorary keeper of the Jodrell Laboratory at Kew in 1892–1906 and foreign secretary of the Royal Society in 1912–16, a leading authority on palæobotany, on January 29, aged seventy-nine years.

Dr. Henry S. Washington, petrologist in the Carnegie Institution of Washington since 1912, an authority on the composition and classification of rocks, especially igneous rocks, on January 7, aged sixty-seven years.

Mr. Edgar Worthington, formerly secretary of the Institution of Mechanical Engineers, on January 23, aged seventy-seven years.

News and Views

Micro-ray Radio Link across the English Channel

ANOTHER milestone in the history of practical radio communication was reached on Friday, January 26, when Sir Philip Sassoon, Under-Secretary of State for Air, officially opened the world's first commercial 'micro-ray' radio service on a wavelength of 17 cm. between the civil airports at Lympne, Kent, and St. Inglevert, France. M. Delesalle, Under-Secretary of State for Air in France, was present at St. Inglevert, and messages of greeting were exchanged, both by teleprinter and by telephone. The inauguration of this service is the outcome of a demonstration given in March 1931 by Messrs. Standard Telephones and Cables, Ltd., who secured the contract for the Lympne installation from the Air Ministry. The corresponding station in France was erected by the associated company—Le Matérial Téléphonique, of Paris. The actual wave-lengths employed in this radio link are 17 cm. in one direction and 17·5 cm. in the opposite direction, and this separation enables duplex working to take place simultaneously by teleprinter and telephone. The teleprinter has been used on land-line commercial telegraph services for some years, and its application to radio communication on this occasion will enable messages to be sent and recorded at a speed of 60–70 words per minute.

THE power generated at each transmitting station of new cross-Channel radio link is less than one watt, a special valve being employed to produce the requisite high-frequency oscillations, which are fed into an aerial about one inch long. This aerial is situated at the focus of a small concave reflector which directs the waves on to a second reflector approximately 10 feet in diameter. The concentrated beam emanating from this arrangement is directed to the similar reflector system used for reception at the distant station. At the Lympne aerodrome, the aerial and reflectors are erected on the roof of a hangar, and are so placed as to command an optically clear path of the corresponding equipment installed on steel towers at St. Inglevert, 35 miles away. Duplicate aerial and reflector systems are employed for transmission and reception. Special feeder lines are led down to the transmitting and receiving apparatus installed in the buildings below. This apparatus provides for the use of telegraphy and telephony in addition to the normal service to be carried on by means of Creed teleprinters. The

object of this new radio service is to speed up the transmission of essential traffic messages, meteorological reports, and so on, involved in the operation of the cross-Channel air routes; and on account of its freedom from interference and its immunity from the effect of weather conditions, the service is likely to be highly successful and to add materially to the safety of air-travel between England and France.

Gas Warfare and Civilian Populations

DR. F. A. FREETH, of Imperial Chemical Industries, Ltd., addressing a meeting of the City of London Branch of the League of Nations Union on January 26, made some caustic comments on the subject of the position of the civilian population in chemical warfare. The topic of chemical warfare has been so forced on the attention of the populace, he said, that the main danger in case of such an attack would be a psychological one. Every chemical industry necessarily uses various kinds of poisonous materials, gaseous and otherwise, in its processes; but as a menace to the civilian population, they are not worth considering. The really 'killing' gases are of low density and in consequence quickly disperse in the atmosphere. As examples, Dr. Freeth mentioned hydrocyanic acid and carbon monoxide, both of which are particularly subtle poisons. Now the exhaust of an idling motor-bus contains about 6 per cent of carbon monoxide and, in consequence, the atmosphere of a narrow thoroughfare like Bond Street in London must, during a busy time, contain considerable quantities of the gas. Yet owing to the ventilation provided by the air, it is not allowed to accumulate. Of the heavier gases used in warfare, Dr. Freeth mentioned chlorine, which requires for its use a quiet atmosphere and a gentle breeze in the desired direction, and mustard gas, which does not spread rapidly and on wet porous soils decomposes. The percentage of deaths to casualties from mustard gas during the War was less than four. If during a gas raid, a man was able to keep his head sufficiently to shut all the windows of his house and put out the fires, he would be able to wait, in reasonable safety apart from a direct hit, until the authorities had dispersed the gas.

Geography and World Citizenship

THE Education Committee of the League of Nations Union has been meeting for some years and initiating and advising methods for making international questions and an international spirit a more integral part of ordinary school and college work. It is largely through the activity of this committee that teachers as a profession stand so firmly by the League of Nations. Meetings and conferences are arranged, lecturers sent out and publications of various kinds issued from time to time. Of the latter, a brochure has just appeared (to be obtained from 15, Grosvenor Crescent, S.W.1, price 4*d*.) on "Geography Teaching in relation to World Citizenship". It is edited by Prof. J. F. Unstead with the help of a number of London teachers of geography and others, and will be approved by all engaged in similar work. The subject has always been regarded in schools as more obviously international than history, and for that reason much of what is said in the pamphlet will appear somewhat commonplace. But there is no objection to enforcing emphatically some of the great commonplaces of human life and thought. It is useful to have set out clearly and in sufficient detail (as here) the main aspect of the inter-relationship of land and people and of the various peoples among themselves throughout the world.

THE attitude of the various contributors to this pamphlet is sane and well-balanced, and they lay stress on those points in their theme which call for most emphasis at the present time. Thus in relation to the mixture of races, it is pointed out that all over Europe—in Germany as well as elsewhere—there has been a blending of stocks, a 'give and take' in blood as well as in ideas. But there is no attempt to pass over, or minimise, the reality or value of the contribution to the whole made by the various national units, based on a definite territorial region. The summary, for example, given of a supposed complete answer to the question, 'What should Italy imply to a well-educated person?', goes from an account of its physiography and natural products to its highest fruit in human genius—Dante, Leonardo, St. Francis, Galileo and the rest. The link is thus brought out between the teaching of geography and history, the more difficult subject. It is understood that a further similar brochure will deal with history.

Lord Derby and the University of Liverpool

THE completion by Lord Derby of twenty-five years as Chancellor of the University of Liverpool was celebrated on January 26 by a special congregation at which honorary degrees were conferred by the Chancellor upon Lady Derby, Lord Halifax (Chancellor of the University of Oxford) and Mr. Stanley Baldwin (Chancellor of the University of Cambridge). Lord Halifax was unable to attend. Following an address by the Vice-Chancellor (Dr. H. J. W. Hetherington) on the growth of the University and the close associations, so long maintained, between Lord Derby, his immediate predecessors, and the University, the graduans were presented by the Public Orator (Prof. Lyon Blease) for the degree of Doctor of Laws. Following the graduation, Mr. Baldwin addressed the congregation and conveyed the congratulations of the University of Cambridge to the University of Liverpool upon the occasion. As the "newest of Chancellors", Lord Halifax conveyed congratulations in writing to both the University and the Chancellor upon the silver wedding of their partnership. In the evening Lord Derby, Lady Derby, The Earl of Crawford and Balcarres, members of the Derby family and the civic heads of the City of Liverpool and Merseyside were the guests at a dinner given by the University Association.

Indian Earthquake of January 15

THE India Office has issued a general survey of the effects of the earthquake. The number of lives lost would appear to be in the neighbourhood of six thousand. The destruction of houses is greatest in the

towns of North Bihar and Monghyr, especially Darbhanga, Muzaffarpur and Motihari. Outside the towns, the principal effects are broken and obliterated roads, the collapse of bridges, floods and great fissures in the ground, from which mud, sand and water have issued, covering fields and crops with a devastating slimy deposit. The central area contains more than 300 square miles under sugar-cane. Though much of this has been saved, nearly all the sugar-mills have been destroyed. The chief difficulties at present are the supply of drinking water and the prevention of epidemics in towns and villages.

Palestinian Remains at the British Museum

THE next special exhibition of prehistoric material at the British Museum will be opened on February 5 and will remain open for two or three months. Two cases at the head of the main staircase, in the Department of British and Mediæval Antiquities, will be devoted to a display of a typical series from stratified caves near Mount Carmel, where excavations have been carried out by the British School of Archæology in Jerusalem and the American School of Prehistoric Research, with Miss D. A. E. Garrod as field-director. Skeletal remains of palæolithic man will be shown (*Palæanthropus palestinensis*), and a sequence of implements from an early phase of the Palæolithic to Mesolithic, the latter being known as Natufian. A special feature of the excavations is the blend of St. Acheul and Le Moustier elements for a period ; and a long succession of Aurignac types gives place to the post-palæolithic with a different and peculiar fauna. The abundant yield is incidentally useful for its similarities and contrasts to the better-known European industries, and special interest is attached to the beginnings of agriculture in Palestine.

Velocity of Light

As was to be expected, the announcement which appeared in the press last summer (NATURE, 130, 25, July 2 ; 277, Aug. 20, 1932) to the effect that the latest experiments indicated a periodic variation in the velocity of light, has been construed in the sense that some seasonal instrumental error was at work. Science Service now issues an official confirmation of this view, given by the Mount Wilson authorities. The report adds that the best value for the velocity of light is now 299,774 km./sec. and that further analysis is only likely to change the last figure by one or two units. The present investigation of the velocity of light is being carried out by Pease and Pearson, who are continuing Michelson's work and using the well-known rotating mirror method. It will be remembered that when Michelson used long base lines between mountain peaks, he found that irregularities in atmospheric refraction—the astronomer's "bad seeing"—interfered with the definition of the reflected image. The base is now *in vacuo*, in a pipe line a mile in length. To obtain more accurate results, it would be necessary to build a more stable pipe line, use quartz mirrors and employ elaborate timing devices.

Projected Electric Railways in Palestine

IN the *Electrician* of January 5 a description is given of a projected railway system for Palestine radiating from Jerusalem. Four new lines will radiate from a terminus at Jerusalem located outside the city on the northern side and east of the Damascus Gate. Possibly recent economic developments in the country, the most important of which is the new harbour at Haifa on the Mediterranean, has tended to emphasise the isolated position of Jerusalem so far as railway facilities are concerned. The northern line is to be 67 miles long, starting from the Jerusalem terminus, going through the Jordan valley, where the line descends to 500 feet below the Mediterranean level, finally getting to Tul Keram Junction on the main Haifa-Cairo line. The eastern line (55 miles) would run from the terminus, crossing the River Jordan, passing through the Kalaat ez Zerka Station on the Hejaz railway to Ammam, the capital of Transjordan and the headquarters of the British Government's High Commissioner. The southern railway (50 miles) would run through Hebron to Beersheba. Finally, there would be a line (18 miles) from Wadi Fara on the northern line through Jericho to the potash works on the shore of the Dead Sea. It is proposed to build a power station and a reservoir in Transjordan and another on the eastern shore of the Dead Sea to provide the electric current for operating the four railways. The latter station would be necessary if an extension railway to the Red Sea should materialise. Some years ago this project was discussed, the terminals of the line being Haifa and the ancient port of Akaba on the Red Sea. This would place Jerusalem on a direct sea-to-sea railway from the Mediterranean to the Red Sea. Possibly it might revive the ancient and prosperous traffic route from the Red Sea to the Levant of the times of Solomon and the Romans.

Transmission of Power by High Tension Direct Current

AT the second World Power Conference held at Berlin in 1930, much consideration was given to international schemes for transmitting large amounts of power by high tension direct current. The most ambitious of these schemes was to transmit one million kilowatts from the western fiords of Norway at a pressure of 500 kilovolts across Sweden and Denmark to the industrial regions in Westphalia, Germany. The great advantage of utilising power from the western fiords is that a uniform output of power all the year round could be obtained. It was proposed that the line should pass through Göteborg and Copenhagen to Hamburg, small amounts of power being tapped off at the two former cities, but the great bulk being delivered to Hamburg for distribution in the German networks. In a paper read to the Institution of Electrical Engineers on January 18, H. Rissik discussed the engineering aspects of the problem. He pointed out that with the same overhead lines, much larger currents can be used with direct than with alternating currents and the difficulties of working are much less with the former than with the latter. On the other hand,

the methods of converting alternating current into high voltage direct current are still in the experimental stage, at least when dealing with power in bulk. Lord Kelvin was a great advocate for the transmission of electric power by direct current, and although most of the difficulties in working with alternating current have been overcome since his time, it is interesting to notice that several engineers still think that direct current will be used for transmission in the future.

Data of Social and Economic Problems

In a recent number of *Planning* (16 Queen Anne's Gate, London, S.W.1) attention is directed to the lack of necessary data on many urgent social and economic problems. A civilisation has grown up under industrialism which calls for enormous resources of knowledge in order to operate it without constant and painful breakdowns. Yet we neither possess the required knowledge nor are we making at present any adequate effort to get it, although its provision offers no insuperable difficulties. Our whole attitude towards the question is still coloured by the prejudices and assumptions of a pre-scientific and pre-technical age. It has yet to be recognised that the same technique which has produced electricity, wireless, fertilisers and new breeds of plants and animals can, if suitably adapted, produce those social, political and economic inventions which we so desperately need.

While the industrial executive in Great Britain and elsewhere has come to recognise that provision must continually be made for new patterns and new techniques, there is no corresponding awareness or equipment for checking and improving the performance of, say, the machinery of government, the health services or the handling of traffic. Immense problems such as the modern scourge of noise, of smoke and chemical pollution in air and water, of street accidents, of crime, of destruction of amenities and many others are allowed to grow up unchecked and almost unobserved. The problem is how to make effective the many demands for new knowledge which are at present frustrated because they do not promise profit to particular individuals or undertakings although they may involve great savings to the community. Obviously one solution would be a great expansion of State-aided research, but much more thought and inquiry would be needed before concluding that this is the only, or the best, solution.

A New Arctic Island

The discovery of a new island in the arctic is now a rare event, but in the *Geographical Review* of January, Mr. V. Stefansson describes what is probably such an occurrence. In September 1931 a party of Eskimo, searching for whales north of Alaska, came to an island on which they went ashore in a position of approximately lat. 71° 20′ N., long. 145° 30′ W. This is about 85 miles north of Flaxman Island and due east of Point Barrow. The island was reported to be about half a mile long and of the same width and to rise to an altitude of about fifty feet. There was some vegetation but no driftwood. Mr. Stefansson vouches for the reliability of the Eskimo Takpuk who led the party and whose name has been given to the island. Further, he discounts the suggestion that the island was merely earth on floating ice. That part of the Beaufort Sea has been little explored though the nearest soundings, some twenty-five miles to the west, show deep water. The question arises as to the possibility of Takpuk Island being Keenan Land, reported in the 'seventies of last century and placed in various longitudes in about lat. 73° N., but this seems more than doubtful. Photographs of Takpuk Island are reproduced with the article.

The *Australian Geographer*

The format has been remodelled and the scope changed of the *Australian Geographer*, the periodical published by the Geographical Society of New South Wales. It is hoped now to publish it more often than once a year and to give special consideration to the work of Australian writers on the geography of the continent. A special feature will be the continuance in every issue of a bibliography of Australian geographical literature. This feature, which begins with the year 1926 in the current issue (No. 1, vol. 2), should prove of considerable value. Another valuable article is that by Dr. M. Holmes in the Australian geographical environment, which treats the subject in much detail.

Philosophy and Everyday Life

The organ of the Philosophical Society of England, the *Philosopher*, enters on its twelfth year of publication under new editorship and in a new and attractive format. As is pointed out in the opening article, the special branches of science have found exponents capable of interpreting their many recent advances to the general reader, and it is the purpose of the *Philosopher* in a similar way to interpret current thought in philosophy and to indicate its contacts with the world of to-day. Thus in the issue before us there is an article on "Reason in Action" by Prof. John Macmurray, another on "Reflection and Common Sense" by Prof. A. E. Heath and another by Paul Painlevé, the distinguished French mathematician, philosopher and statesman who died towards the end of last year, on "Civilisation and Modern Science". Students of philosophy will perhaps turn more readily to the "Courses of Study", where notes are given on various aspects of the subject, with suggestions for further reading. There are also reviews and notices of recent books, a section on educational intelligence, a record of meetings of the Philosophical Society and so on. The journal has thus a double appeal, to the layman and to the student, and at the modest price of 6*d.* should have a wide circle of readers. Copies of the *Philosopher* can be obtained from the Honorary Secretary of the Philosophical Society, 13 Woodlands Road, London, S.W.13.

Physica

The first number of the new Dutch periodical *Physica* (December 1933, pp. 96, published by Martinus Nijhoff, The Hague, 25 guilders yearly)

contains a number of interesting papers. The paper by de Haas and his co-workers on the attainment of very low temperatures by adiabatic magnetic changes is referred to in our Research Items (p. 181). Druyvesteyn describes experiments on the low-voltage arc in sodium vapour. The absorption of the *D* lines was measured in the arc and the reversal of the *D* lines against a continuous source at variable temperature was observed. The results show that the number of excited sodium atoms is about 12 per cent of the number of the normal atoms, and that the number of Na^+ ions is several times the number of normal atoms. The theory of light emission in gaseous discharges is discussed by W. De Groot. Van Heel describes a quartz-fluorite combination lens which is achromatic and spherically connected. It is intended for focusing light on a thermocouple with unit magnification. P. Cohen Henriquez describes a micro-apparatus for determining the dipole moment of organic solutes. The apparatus may be used with a few milligrams of material. The ratio of the lithium isotopes has been determined by intensity measurements of the fine structure of the Li resonance line by Ornstein, Vreeswijk and Wolfsohn. Van Kreveld describes an empirical summation law for a photographic plate exposed to light of two or more colours, and Van der Pol and Weyers describe the approximations known as Tchebycheff polynomials. The papers are in English or German, and in some cases German papers are provided with an abstract in English.

Recent Acquisitions at the British Museum (Natural History)

AMONG the recent acquisitions at the Natural History Museum the Department of Zoology has received as a donation from Mrs. Charles Buckley and Mr. Godfrey R. Buckley the mounted head of a cow of the Chartley breed of cattle. Chartley Park was formed by enclosing about 1,000 acres of the forest of Needwood in the reign of Henry III, when a number of half-wild cattle, which then roamed throughout the district, were driven in and enclosed in the Park. Two important additions have recently been made to the beetle collections in the Department of Entomology, namely the Donisthorpe collection of British Coleoptera and an Australian collection purchased from Mr. W. du Boulay. The former contains upwards of 22,000 specimens, and is of especial interest in that it is accompanied by the most complete set in existence of the numerous British insects (mainly beetles) and other arthropods that live in association with ants and are known as myrmecophiles. The du Boulay collection, which numbers only 352 specimens, consists, however, entirely of beetles actually found inhabiting ants' nests in various parts of Australia by Mr. du Boulay over a period of sixteen years. Mr. R. E. Turner, working in South Africa, has collected and presented to the Museum some 8,000 insects of various kinds, principally small bees and wasps; and from the mountains of New Guinea Miss L. E. Cheesman has collected for the Museum upwards of 18,000 specimens. Miss M. Graves, M.P., has presented to the Geological Department some portions of the egg-shell of a small horned dinosaur, *Protoceratops andrewsi*. The South Australian School of Mines and Industries has presented an end-slice of a large mass (2,520 lb.) of meteoric iron found in 1909 at Murnpeowie, South Australia, previously represented in the collection only by a cast of the whole mass.

Sunday Lectures at the British Museum (Natural History)

FOR the benefit of visitors to the Natural History Museum on Sunday afternoons who may wish for fuller information about the various branches of natural history than may be obtained by casual wandering through the galleries, the Trustees of the British Museum have arranged for two lectures each afternoon at 3 and 4.30, to be given usually by a member of the scientific staff. Lectures illustrated by lantern slides will be given in the Board Room, and the remainder in one of the galleries. The opening lecture will be on Sunday, February 4, the lecturer being Capt. Guy Dollman, who will speak on the great game animals of Africa and will show a number of lantern slides. On succeeding Sundays lectures will be given by Dr. W. E. Swinton on earthquakes, Mr. Maurice Burton on seashore animals (both in the Board Room), and Mr. J. R. Norman on the Fish Gallery. Admission to the lectures is free.

THE Department of Botany of the Natural History Museum has received a bequest of the herbarium of the late Ashley H. Maude. The specimens are well mounted on about 5,000 sheets and are in good condition, contained in four cabinets. They are chiefly European but there are also collections from Algeria, Cape Colony and the Canary Islands. The Godman Trustees have presented 534 specimens of flowering plants collected by Mr. F. Ludlow and Capt. G. Sherriff in Bhutan. The area traversed is one which is not very well known botanically and as each 'number' comprises a good series of well-dried plants the collection is of great value. A number of seeds were also collected, and these have been distributed. This year's collecting season in Nepal was ruined by the monsoon and consequently only fourteen specimens were collected by Prof. K. Sharma. These were presented to His Majesty the King and placed by him on loan in the Department of Botany. Although the number is small it includes several very important horticultural plants.

Empire Museums and the Carnegie Corporation

IT is gratifying to learn (from the December number of the *Museums Journal*) that the Carnegie Corporation has decided to grant substantial sums for the development of the museums of the Empire, following upon the Empire Survey of Museums, to which reference has been made in these notes. Already grants totalling 50,000 dollars have been made in Canada, and it has just been made known that similar sums have been set aside for South Africa, Australia and New Zealand. These will be administered by local committees. In addition to the 200,000 dollars thus earmarked, the Carnegie Corporation has also decided to appropriate 63,000

dollars to the Museums Association for a programme of museum development in Newfoundland, Southern Rhodesia and the Colonies.

A Direct Reading Universal Drawing Compass

MR. THOROLD, 20, Rathbone Place, W.1, sends us particulars of a new instrument which is a combination of scale and compass. The compass points travel on a beam carrying interchangeable scales. The two points terminate in movable heads on the beam which are adjustable, one possessing a micrometer. The instrument is also supplied with calliper points for external and internal measurements. The maker claims that great accuracy is obtainable, and for fine drawing in the field of physical science and engineering the invention seems likely to be valuable. The cost of the instrument is £7 7*s*.

Austrian Ethnographical Expedition to West Africa

AN expedition, of which Dr. Ralph Elber, of the Institute of Egyptology and African Studies, is the leader, left Vienna, according to a communication issued by the Reichszentrale für Wissenschaftliche Berichterstattung, Berlin, early in January for Sierra Leone, whence it will proceed to Liberia for the purpose of exploring the interior of the country and observing the little-known tribes of that region. Special attention will be given to the study of the religious and magical beliefs of the tribes and their languages, which are virtually unknown. The results of this expedition should be of special interest in view of present lack of knowledge of the area, its inhabitants and natural history. It is also hoped to add to the map particulars of one of the last uncharted areas of Africa.

Pittsburgh Award of the American Chemical Society

THE Pittsburgh Section of the American Chemical Society has selected Dr. Ralph E. Hall, director of the Hall Laboratories, Inc., Pittsburgh, Pa., as the recipient of the 1933 (the first) Pittsburgh Award. This honour, which will be conferred on Dr. Hall at the sectional meeting on February 15, is in recognition of his distinguished service to chemistry and humanity, particularly his contributions to the fundamental knowledge of boiler-water reactions and their applications to the practical solution of boiler-water problems, his discoveries and technical accomplishments in the beneficiation and conditioning of water for industrial and domestic use, and his developments in the production of chemicals for these purposes. The Pittsburgh Award is represented by a plaque of gold, on which the relation of chemistry to industry is symbolised.

Announcements

SIR WILLIAM LARKE, K.B.E., Director of the National Federation of Iron and Steel Manufacturers; Prof. Edward Mellanby, F.R.S., Secretary of the Medical Research Council; and Mr. Leonard Woolley, Director of the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania to Mesopotamia, have been elected members of the Athenæum under the provisions of Rule II of the club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

SIR ARTHUR EDDINGTON will deliver the Rickman Godlee lecture at University College, Gower Street, London, W.C.1, on Friday, February 16, at 5.30 p.m. The subject of Sir Arthur's lecture will be: "The Constitution of the Stars". The lecture will be open to the public.

PROF. A. ZIMMERN, Montague Burton Professor of International Relations in the University of Oxford, is giving a course of six lectures (Muirhead Lectures in Social Philosophy) at the University of Birmingham on Thursdays, beginning on February 1, on "Britain and the World Crisis".

MISS NINA SYMINGTON, daughter of the late Prof. Symington of Belfast, has bequeathed the residue of her estate, amounting to some £9,000, to be known as the Johnson Symington Memorial bequest, to the Anatomical Society of Great Britain and Ireland for anatomical research.

THE Council of the Institution of Naval Architects has awarded the Gold Medal for the year 1933 to Eng.-Capt. S. R. Dight, for his paper on "Naval Water-Tube Boilers. Experiments and Shop Trials"; and the premium to Dr. George Hughes, of the William Froude Laboratory, for his paper on "The Effect of Wind on Ship Performance".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemical assistant to the advisory chemist in the Department of Agriculture, University of Cambridge—The Secretary, School of Agriculture, Cambridge (Feb. 10). A junior assistant (chemist) in the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Feb. 10). A head of the Department of Civil Engineering and Building, and a head of the Science Department in the Lester School and Institute, Shanghai—Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (Feb. 20). A director of the University School of Librarianship at University College, London—The Academic Registrar, University of London, S.W.7 (March 1). A University lecturer in moral science in the University of Cambridge—The Secretary of the Faculty Board of Moral Science, King's College, Cambridge (March 1). A University lecturer in forestry in the Department of Agriculture of the University of Cambridge—The Secretary, School of Agriculture, Cambridge (April 14). A keeper of the Museum at the Victoria University of Manchester—The Registrar (April 30). A research assistant (male) in the Cancer Research Department of the Westminster Hospital, Broad Sanctuary, London, S.W.1—The Secretary. A registration officer and statistician, and a finance officer and accountant for the Potato Marketing Board—The Secretary, Potato Marketing Board, 45 Bedford Square, London, W.C.1.

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.*]

Designation of Heavy Hydrogen

IN a recent issue of NATURE (**132**, 955; 1933) Lord Rutherford has suggested that the heavy isotope of hydrogen be named diplogen, instead of the name deuterium proposed by us. This was one name considered by us before we published our suggestion of the names protium and deuterium for the two isotopes of hydrogen.

Our objection to this name arises from the difficulty of naming compounds which contain two of the heavy hydrogen atoms. Thus the compound $NH^1H_2^2$ would be called di-diplogen mono-hydrogen nitride. The part of this name which we think is unfortunate is the repetition of the syllable 'di' in the name, and it was for this reason that we discarded this name for the heavy isotope. Also, we believe that the two isotopes of hydrogen should be treated symmetrically, and the corresponding name, haplogen, for the hydrogen of mass 1, did not appeal to us. Moreover, both names have a rather forced meaning. 'To generate double' and 'to generate single' seem to have no evident applicability to the hydrogen isotopes such as the corresponding meaning of the word hydrogen has.

The objection to the name deuterium for the substance H^2 and the name deuton for its nucleus, seems to be founded upon the possibility of confusing the word neutron and the name deuton. Perhaps the use of the name deuteron would eliminate this difficulty. It is interesting indeed that American scientific workers do not have any such difficulty so far as we are aware.

It may be of interest to readers of NATURE in connexion with the discussion of names for this substance if we list some of the names considered by us before we proposed these names. These include :

Haplogen for H^1 and diplogen for H^2. These names were discarded for the reasons given above.

Hydrogen for H^1 and bar-hydrogen for H^2, with the symbol $\bar{H}$ for the latter. This we discarded because it is a four-syllable word and because people generally seemed to dislike the sound of it. Thus di-bar-hydrogen would occur in some chemical compounds and the two prefixes seem very awkward.

Barogen for H^2 and pycnogen for H^2. Both these names were eliminated because they did not sound euphonious and also because we feared that it was emphasising the increased density of the compounds too much.

Iso-hydrogen for H^2. This was eliminated because the term iso is a common term for naming organic compounds.

Dygen for H^2. We eliminated this name because of the impossibility of making any of the usual chemical combining terms.

We finally agreed upon the names protium and deuterium because they place the two isotopes of hydrogen as equal, both being hydrogen, and because of their meaning as first and second, and because we felt they were the most descriptive of these names. We were influenced in the selection of deuterium by the preference of others for the name deuton, though we preferrred to use the entire Greek stem rather than to abbreviate it.

As Lord Rutherford states, the question of naming this isotope is so important that a general discussion of the name is very desirable at this time. We are not only giving a name to a single isotope, but we are perhaps also introducing a system for naming other isotopes in the future. Whatever names are finally selected, we do believe that both isotopes of hydrogen should be named and the name hydrogen be used to apply to both of them, and that this principle be adhered to in the future in naming any other isotopes. This question of course is not important at the present time, but we think that it would be too pessimistic to believe that other isotopes will not be separated in quantity in the future.

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CHEMISTS cannot admit such fearsome wild fowl as *Diplogen* to their sanctuary of elements—elements no longer, subject as they are to protono-decapitation and reheading to satisfy simple sums. Diplogen is an offence against the usages of the house chemical, philologically unsound and bereft of reason. The *gens* are all gentles with specific functions : hydrogen the *gen* of water ; oxygen the *gen* of acid ; nitrogen the *gen* of nitre. Diplogen, the gen of twins, can have no place in such company. Diplog*in*, if you will, as it has so gone to the heads of physicists—but Diplog*en*, never ! It's a twin not a twinner. Fish will leave the waters, if they learn that such a monster is around.

Why not simply *Deuthydrogen*, as it is the second term in the hydrogen series ? Should a Triton appear among these minnows, it will be Trithydrogen. We shall then be naming it in accordance with the principle adopted in homologous hydrocarbon series. After all, the American parents alone have the right to decide what the child's name shall be—whatever Dr. Aston may assert. Still, he is scarcely to be ranked as an authority—as he will not recognise distinction between 'composition' and 'constitution'. Much measuring has made him oblivious of meanings.

We notice elsewhere a suggestion of the name *Woollywestium*, Ww. Such a name would invite its wearing next the skin, whilst taking cognisance of a Californian birthplace.

We cannot allow physicists to muddle our language : as they have done in their varied misuse of Faraday's incomparable term ion ; in their continued failure to distinguish between atom and molecule—to give only two examples. Their ruin of the significance of ion is a disaster, an insult to Faraday's memory ; our literature is thrown into entire confusion thereby.

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Activities of Life and the Second Law of Thermodynamics

I AM very glad to have elicited Prof. F. G. Donnan's critical views (NATURE, Jan. 20, p. 99) on my suggestion as to life and thermodynamics, but confess I remain unconvinced by his arguments.

Prof. Donnan challenges my neglect of the body metabolism or fuel oxidation which, as he says, necessarily accompanies the arrangement or disarrangement of material objects by human activities, considering that such chemical changes may produce an increase of entropy sufficient to offset any decrease produced by human intelligence. No doubt it may, but I cannot see that these two effects are "functionally inter-related" or in any way suitable subjects for comparison. Given perfectly level and frictionless railways, a man may move millions of tons of matter, and thereby decrease the entropy of the world enormously, without incurring any corresponding increase of entropy through the combustion of food or fuel. Any increase of entropy which occurs in practice is a mere side-issue, an accident resulting from the impossibility of realising ideal conditions, and so should not enter into the theoretical discussion at all.

A further increase of entropy might of course occur if the mental effort of arranging objects caused an increase in bodily metabolism. I believe orthodox physiology teaches that any such effect is inappreciable, but it is in any case obvious that it cannot be relied on to offset the decrease of entropy resulting from intelligent arrangement. We cannot, for example, suppose that the man who steers the *Mauretania* consumes food-energy at a rate comparable with 100,000 h.p. more than normal, merely because he is guiding a ship of that horsepower.

Prof. Donnan's parallel from crystal growth seems to me to fail through identifying "increase of organisation" with "decrease of entropy". The two are equivalent so long as potential energy is unimportant, but when this becomes preponderating, as in a crystal, maximum entropy may well demand regular packing, and so *maximum*, not minimum, organisation.

J. H. JEANS.

Crystal Structure of Lanthanum, Cerium and Praseodymium Hydrides

THE original metals were: La α (hexagonal close packed arrangement, $a_0 = 3{\cdot}75_7$ A., $c/a = 1{\cdot}61$); Ce β (face centred cubic, $a_0 = 5{\cdot}14_6$ A.; Pr α (hexagonal close packed, $a_0 = 3{\cdot}65_2$, $c/a = 1{\cdot}61$).

Lanthanum annealed in vacuum at 350° C., for several days, furnished powder photographs similar to those described very accurately by Zintl and Neumayr[1] for the β phase (face centred cubic) of this element. I have noticed that by removing a very thin outer layer from the annealed specimens, the latter gave again the characteristic photographs of the α modification, that is, it was merely a surface phenomenon.

Praseodymium subjected to the same thermal treatment did not modify its structure. The specimens annealed in vacuum at 750° C. for 48 hours furnish photographs of a somewhat different aspect, but yet not corresponding to a possible allotropical β form.

The difficulty of hydrogen absorption increased in the order cerium, lanthanum, praseodymium. In any event, the thermal treatment which was necessary to start the hydrogen absorption, repeated in vacuum on some specimens of the last two elements (α modification), did not change their crystal structure.

The hydrides of the above mentioned metals all showed face-centred cubic lattices, with sizes larger than those pertaining to the real or possible β phases of the original pure elements.

Lanthanum hydride furnished in one case photographs revealing the simultaneous presence of two face-centred cubic phases, having for side $a'_0 = 5{\cdot}62$ A.; $a''_0 = 5{\cdot}70$ A. (hydrogen absorbed, about 140 c.mm. per gm.). Generally, however, only one face-centred cubic phase appeared, having a side of $a_0 = 5{\cdot}62$–$5{\cdot}63$ A. (hydrogen absorbed, about 200 c.mm. per gm.). If the hydrogen was removed by heating and a vacuum pump (at 1 mm. pressure) the size of the lattice seemed to increase a little (at 530° $a_0 = 5{\cdot}65$ A.; at 700° slightly greater values).

Cerium hydride showed a lattice with side $a_0 = 5{\cdot}61_2$ A. which by removal of the hydrogen in vacuum at 530° split up into two similar phases of slightly smaller dimensions.

The lattice of praseodymium hydride (absorbed hydrogen, about 165 c.mm.) was only slightly larger (some hundredths of an angström) than that of metallic cerium, that is, than that which a hypothetical β phase of praseodymium would give, according to the small existing difference between the atomic diameters of praseodymium and cerium in the α phase.

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R. Università di Firenze.

[1] *Z. Elekt. ang. phys. Chem.*, **39**, Nr. 2, 84; 1933.

Magnetic Anisotropy of Graphite

GRAPHITE is known from the investigations of Owen, Honda and others to exhibit an exceptionally large magnetic anisotropy. The susceptibilities of the natural crystal along its hexagonal axis and along perpendicular directions are, according to Honda[1]:

$$\chi_1 = -14{\cdot}2 \times 10^{-6}; \quad \chi_2 = -2{\cdot}2 \times 10^{-6}$$

respectively, per gm., χ_1 being thus more than six times χ_2. Recently Goetz and his collaborators have found a much higher value for the ratio χ_1/χ_2. Chemically treated pure graphite powder is dispersed by them in a solution of gum Dammar in benzene; the solution is placed in a strong magnetic field and the benzene is allowed to evaporate. All the graphite particles in the solidified medium will then naturally be oriented in the same manner, namely, with their hexagonal axes normal to the direction of the imposed field. From susceptibility measurements on this medium they found[2] for χ_1/χ_2 a value of 13·2. Later[3], using graphite particles dispersed in this manner in a solidified solution of agar, they obtained a still higher value, namely, 18. Their more recent estimate[4], obtained from a similar suspension of graphite particles in gelatine, is so high as 28. It would thus seem desirable to determine the anisotropy of graphite by an independent method.

The following measurements made with some good specimens of Ceylon graphite, by Messrs. B. C. Guha and B. P. Roy in this laboratory, may therefore be of interest. The method adopted in these

measurements was the same as was described in previous papers[5]. By suspending the crystal, with its hexagonal axis horizontal, at the end of a calibrated quartz fibre, in a uniform magnetic field, and measuring the couple due to the magnetic anisotropy of the crystal, the *difference* between the two principal susceptibilities, namely, $\chi_1 - \chi_2$, was determined. With the same suspension, the absolute value of χ_2 was measured by magnetically balancing the crystal in a field of large non-homogeneity, against an aqueous solution of potassium iodide, the susceptibility of which could be adjusted by suitable dilution.

Altogether ten different crystals were measured for $\chi_1 - \chi_2$, and the values obtained ranged from $-21{\cdot}8 \times 10^{-6}$ to $-23{\cdot}0 \times 10^{-6}$ per gm. The values for χ_2 varied about a mean value of $-0{\cdot}4 \times 10^{-6}$. Hence the principal susceptibilities of these crystals per gm. are:

$$\chi_2 = -22{\cdot}8 \times 10^{-6}, \chi_1 = -0{\cdot}4 \times 10^{-6}.$$

210 Bowbazar Street, Calcutta. Nov. 23. K. S. KRISHNAN.

[1] "Int. Crit. Tables", **6**, 364.
[2] *Phys. Rev.*, **39**, 168; 1932.
[3] *ibid.*, **39**, 553; 1932.
[4] *ibid.*, **40**, 1053; 1932.
[5] *Phil. Trans.*, A, **231**, 235. **232**, 99; 1933.

Rate of Ionisation of the Atmosphere

THE rate of atmospheric ionisation (q), as calculated from observations of small ions and nuclei, has been found to attain a maximum at approximately 18 hours G.M.T. in such widely separated localities as Glencree[1], Washington[2] and Canberra[3].

Recently a series of direct observations of q has been completed at the Commonwealth Solar Observatory. A large 'unshielded' ionisation vessel was refilled with the outer air at hourly intervals and the saturation currents measured. The hourly means of observations extending over forty complete days were:

G.M.T.	q	G.M.T.	q	G.M.T.	q	G.M.T.	q
0	25·6	6	21·5	12	29·6	18	37·3
1	23·6	7	23·8	13	32·0	19	35·4
2	21·3	8	24·1	14	32·0	20	35·1
3	21·5	9	26·0	15	33·4	21	31·9
4	21·4	10	27·6	16	35·9	22	32·0
5	21·4	11	28·4	17	38·0	23	29·2

The columns headed G.M.T. show the hour at which the filling of the vessel was completed; those headed q give the rate of ionisation of the air in the vessel in ion pairs per cubic centimetre per second.

A ten-day series of observations, made upon a sample of air which had been confined in the vessel for four weeks, showed the background ionisation to be 15·6 ion pairs per c.c. per second, and to be constant to within ± 1 per cent throughout the day.

Although the above figures may be subject to certain small corrections, they show that the rate of ionisation of the lower atmosphere undergoes considerable diurnal variation.

Whether the approximate agreement of the maximum at Glencree, Washington and Canberra is more than a chance coincidence can be determined only by observations in other localities.

Commonwealth Solar Observatory, Mount Stromlo, Canberra, F.C.T., Australia. Dec. 1. A. R. HOGG.

[1] J. J. Nolan and P. J. Nolan, *Proc. Roy. Irish Acad.*, **40**, 11; 1931.
[2] G. R. Wait and O. W. Torreson, NATURE, **129**, 401, March 12, 1932.
[3] A. R. Hogg, *Gerl. Beitr. Geophys.* (in press).

Ionospheric Measurements in the Polar Regions

THIS note is a brief account of the results of wireless observations made in connexion with the International Polar Year 1932–33 at Murmansk (lat. 68° 56′ N., long. 33° 05′ E.) in the U.S.S.R. during June, July and August 1933. This work was organised by the Leningrad Section of the Institute for Scientific Research of the People's Commissariat for Communication in association with the Central Geophysical Observatory and was carried out under my direction.

A special system with two 150-watt tubes was designed in order to send out short pulses of 20 kw. energy. This was accomplished by using a condenser charged to high tension by a rectifier. By means of a rotary spark gap, this condenser was discharged fifty times per second through the plate circuit of the tube oscillator, in which short oscillations of great power were thus produced. The rest of the time the condenser was not connected to the oscillator and the charge was gradually stored up. Thanks to this method, it has been possible to carry out experiments under the conditions of an expedition, using but a small power.

The observations were made with a cathode ray tube; the circular motion of the spot was caused by the current of a small alternator, driven on the same shaft as the transmitter discharger. The transmitter and the receiver were separated by a distance of three kilometres and connected by wire.

Several unusual phenomena were found which must have been due to specific conditions of the ionosphere in polar regions. Shortly, the results obtained may be summarised as follows:

In the polar regions during the summer solstice and for some time after, both the main reflecting layers E and F of the ionosphere are found to exist. The E layer is in general less active than in temperate latitudes and therefore but seldom capable of screening the F layer. It is mostly in evidence for waves of 75 m. and 110 m. around midnight and occasionally by day.

The daily variations of ionisation are in some cases similar to those in temperate latitudes, whereas sometimes they were of an opposite character. Pictures for noon and midnight were nearly always alike, but differed from those for intermediate hours.

Very complex reflections from the upper region are due to the stratified or undulatory structure of the ionosphere. Rapid motion is found to exist in this layer.

No increase of the shielding effect of the E layer and no changes in absorption have been observed at times when this layer dropped to a height of 65 km. This seems to indicate that in this case such a low level of the E layer is due to changes in the distribution of gas pressure at great heights and corresponds to a deep barometric minimum of the upper atmosphere.

Periods of complete cessation of echoes have been observed, which lasted sometimes for several hours; sometimes, however, the echoes were absent only for one minute or even less. The picture of reflections before and after such a short absence of echoes was found to be the same.

Such observations suggest that this disappearance of echoes is due to some factor, having the character of a screen, placed between the observer and reflecting layer at an intermediate height; or, it may be said, that a separate 'absorbing layer' is produced at times below the E layer, at a height probably less than 65 km.

The character of these phenomena offers some basis for explanation of the structure of this layer: it may be composed of separate moving masses, shielding the Kennelly-Heaviside layer (as does a cloud, when it covers the sun) or produced by some variable agent, and is able to appear and disappear very rapidly. Further light might be thrown on this question by comparing moments of echo cessations at two points not very far apart.

No correlation was found between the changes taking place in the *E* and *F* layers and the presence or absence of the absorbing layer. Therefore the absorbing layer must be considered as an independent formation quite apart from the *E* layer and due to other agencies than the *E* and *F* layers.

There is undoubtedly direct correlation between the phenomenon of echo cessation and magnetic activity.

The difficulty caused by magnetic storms of maintaining continuous wireless communication over high latitudes may be attributed to the existence of the absorbing layer.

These results agree in general with those obtained by Prof. E. V. Appleton during his observations at Tromsø (NATURE, Sept. 2, p. 340).

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Nov. 14.

Basking Shark in the Bab el Mandeb

WHEN passing through the Strait of Bab el Mandeb in November 1933 on board the Dutch mail steamer *Johan van Oldebarnevelt*, my attention was directed to the fact that a big fish was fastened on the bow of the vessel. So long as the latter continued running at full speed, the shape of the fish could not well be determined. It was evident only that the enormous tail was turned to the right side and could be seen moving now and then as if the fish were still alive, the tip reaching the surface of the water occasionally.

After the vessel had diminished its speed and finally stopped, what I had suggested was confirmed, namely, that we were dealing with the big 'whale shark' or 'basking shark' (*Rhineodon typus*). The shape and the very conspicuous colour-pattern (white lines, intersecting each other at right angles, and white blotches on a black ground) could be very clearly distinguished. The animal had been 'rammed' by our vessel in a similar way to that already recorded by E. W. Gudger for the same species in a few cases, just behind the left pectoral fin, so that it could not free itself and remained fastened with the left side of the back to the sharp bow of the ship. After the ship had stopped the fish got free, showing a big wound on the left side and sinking down slowly into the depth. I could not state with certainty whether it was still alive. I estimate its length at 6–8 metres.

As stated above, similar cases of this kind have been recorded by Gudger, namely, one that happened near Abrolhois Light off the coast of Brazil, and another near the mouth of the Sassandra River in the northern part of the Gulf of Guinea.

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New Methods for Direct Visualisation of Ultra-sonic Waves and for the Measurement of Ultra-sonic Velocity

MEASUREMENTS of ultra-sonic velocities in liquids can be easily made by the method of Debye and Sears or Lucas and Biquard[1], who used the periodically alternating densities produced in a liquid by ultra-sonic waves as an optical grating. Such measurements have been made in this department at the suggestion of Prof. H. Falkenhagen, who wanted

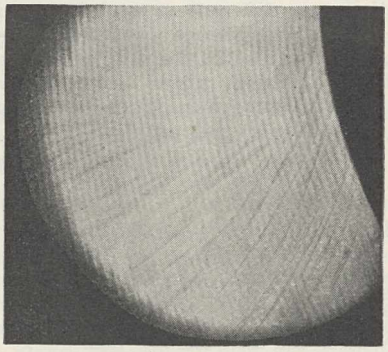

FIG. 1. Stationary ultra-sonic wave formed at a convex mirror.

more precise data on the compressibilities of electrolytic solutions. In the pursuit of these researches we have found it preferable to visualise this 'optical grating' directly instead of using it for the diffraction of light. Details of the new method will be given in a forthcoming publication in the *Zeitschrift für Physik*. The picture reproduced as Fig. 1 is a photomicrogram of a stationary ultra-sonic wave formed at a convex mirror in xylol, frequency about 4500 kHz. It is possible to measure the distance of the nodal lines very precisely. By measuring a great number of nodal lines, we are able to make measurements of ultra-sonic velocities in liquids with the highest precision.

In order to clear up some theoretical problems on which such successful pioneer work was done by R. W. Boyle[2], it is necessary to use progressive waves instead of stationary ones. We succeeded also in the direct visualisation of ultra-sonic progressive waves by using a high-frequency stroboscope based on the principle of the Kerr cell. This enables us to study a sound field without disturbing the field itself. We can also measure directly with a microscope or a comparator the distance of subsequent wavefronts of progressive ultra-sonic waves. This is another new method for the measurement of ultra-sonic velocity with the highest precision.

The advantages of our new methods will be discussed elsewhere shortly.

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H. R. ASBACH.

Abteilung für Elektrolytforschung am physikalischen Institut, Universität, Köln.
Dec. 23.

[1] P. Debye and F. W. Sears, *Proc. Nat. Acad. Sci.*, **18**, 410; 1932. R. Lucas and P. Biquard, *J. Phys. et le Rad.*, **3**, 464; 1932.

[2] R. W. Boyle, J. F. Lehmann and C. D. Reid, *Trans. Roy Soc. Canada*, **19**, 167; 1925; and many other papers by Boyle and co-workers.

The Mechanism of the Kolbe Reaction

IT has been observed by us that a variety of substances which are good catalysts for the decomposition of hydrogen peroxide produce a marked deviation of the anodic processes occurring during the electrolytic oxidation of thiosulphate[1] and of sulphite[2], and in the liberation of halogens[3]. We have now found that in the electrolysis of acetate solutions, relatively small amounts of plumbous, manganous, cupric, ferrous or cobaltous ions have a profound influence on the course of the Kolbe reaction. For example, the addition of 0·001 *M*-lead acetate to a solution containing *N*-potassium acetate and *N*-acetic acid reduces the efficiency for ethane formation at a platinum anode from about 70 per cent almost to zero, when using a current density of 0·025 amp. per sq. cm.

The effects of the ions mentioned are in the order $Pb^{\cdot\cdot} > Mn^{\cdot\cdot} > Cu^{\cdot\cdot} > Co^{\cdot\cdot} = Fe^{\cdot\cdot}$, and an independent consideration of their catalytic influence on the decomposition of hydrogen peroxide, under the conditions prevailing at the anode during the electrolysis of an acetate solution containing acetic acid, has led us to arrange these ions into the groups $(Pb^{\cdot\cdot}, Mn^{\cdot\cdot}) > (Cu^{\cdot\cdot}, Co^{\cdot\cdot}, Fe^{\cdot\cdot})$. This parallelism suggests the possibility that hydrogen peroxide is the effective agent in the formation of ethane by the Kolbe reaction, just as it appears to be in the other anodic oxidation processes we have studied.

A comprehensive investigation of the mechanism of the Kolbe synthesis was commenced some time ago, but as a period is likely to elapse before the final conclusions are ready for publication, we consider it desirable to make a preliminary announcement of the important observations relating to the effect of catalysts for hydrogen peroxide decomposition.

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A. HICKLING.

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Jan. 5.

[1] *J. Chem. Soc.*, 2345, 2800; 1932.
[2] *ibid.*, 829; 1933.
[3] *ibid.*, in the press.

Possible Chemical Nature of Tobacco Mosaic Virus

IN a recent issue of NATURE[1] Barton-Wright and McBain give results of experiments on the precipitation of virus from infected tobacco juice. The method they used was that of Vinson and Petre, which consists essentially of the precipitation of the protein and other materials from the plant juice with basic lead acetate and the subsequent removal of the virus by elution with potassium-hydrogen phosphate solution. Barton-Wright found that if the mixed phosphate eluate be acidified to a *p*H of 5 (which means, in effect, the conversion of the alkaline to the acid phosphate, KH_2PO_4) and 2 volumes of acetone added, a precipitate is thrown down, which is partly colloidal and partly crystalline. The colloidal material is largely protein in nature and is rich in virus. The crystals also contain virus.

I have been working on similar lines for the past two years, and I am in agreement with Barton-Wright and McBain up to this point. Barton-Wright and McBain, however, claim that they have been able to purify the crystals by repeated recrystallisation until they contain no nitrogenous material but still contain virus, and that no crystalline material was formed from healthy juice similarly treated. My experience may be of interest in this connexion. I have determined the presence of virus in the crystals quantitatively as well as qualitatively, using the N. glutinosa method. In the original crystals there is a small virus content and some protein. As the crystals are washed and reprecipitated, virus appears in the supernatant liquid, and at each recrystallisation the amount of virus in the crystals is reduced. After repeated treatment the crystals still contain a little virus, much less than originally, and they still contain a trace of organic nitrogen on microanalysis. Nitrogen-free virus-containing crystals have not been obtained. I have found no evidence that the crystals contain virus except as an impurity.

That the crystals have no specific relation to the virus is easily demonstrable. If the K_2HPO_4 eluate from healthy tobacco tissue be acidified as was that of the infected material and two volumes of acetone added, a crystalline as well as a colloidal precipitate is obtained, despite the statement of Barton-Wright and McBain. The amount of this crystalline portion of the precipitate depends on the concentration of the phosphate solution used in the elution of either the healthy or the infected juice. If an $M/1$ K_2HPO_4 solution be used, the precipitate of crystals is very large.

It can readily be shown that the crystals are due to the presence of KH_2PO_4 by the fact that the addition of two volumes of acetone to one of $M/1$ KH_2PO_4 in aqueous solution results in a heavy white precipitate of rhombic crystals, indistinguishable in outline from those obtained in the experiments recorded above.

JOHN CALDWELL.

Rothamsted Experimental Station.
Jan. 23.

[1] NATURE, **132**, 1003, Dec. 30, 1933.

Activity of Crystalline Preparations of Vitamin B_1

IN an important letter, Dr. van Veen[1] describes the isolation of a vitamin B_1 preparation from rice polishings more potent by rice bird tests than our own. At the same time he mentions that his activity reaches 500,000 units per gm. It is well to realise that some of our most potent specimens have shown this activity by pigeon test[2], so that a final judgment upon the question must await further work.

In addition to the strong probability that most vitamin B_1 crystals contain inactive vitamin, we must reckon with the further complication of different analytical figures. Dr. van Veen's new crystals have the same analytical figures as previously, whereas repeated work shows that analysis of our crystals differs significantly and constantly from his (and others) in several respects, for example, C 42·2 per cent instead of 40·7 per cent. Hence active torulin (from baker's yeast) appears to be different from active oryzanin. At present these differences cannot be reconciled with the published results of X-ray analysis[3].

We acknowledge with gratitude a specimen of Dr. van Veen's B_1, which is now under test.

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J. R. O'BRIEN.
R. A. PETERS.

Department of Biochemistry,
Oxford.
Jan. 27.

[1] NATURE, **133**, 137, Jan. 27, 1934.
[2] *Biochem. J.*, **27**, 232; 1933.
[3] NATURE, **131**, 911, June 24, 1933.

Refractive Indices of *l*-Ascorbic Acid

E. G. Cox[1] states that *l*-ascorbic acid is optically negative with $\alpha = 1{\cdot}462$, $\beta = 1{\cdot}68$, and $\gamma > 1{\cdot}70$. We have examined a material isolated from peppers after the method of A. Szent-Györgyi[2] by Dr. A. G. Grollmann, of the Johns Hopkins Medical School. This substance gives the characteristic absorption spectrum of *l*-ascorbic acid with a maximum coefficient[3] at 2650 A.; the melting point is 188°, and the analysis (Mrs. M. S. Sherman) C, 40·80 per cent, H, 4·78 per cent (calculated for $C_6H_8O_6$; C, 40·89 per cent, H, 4·58 per cent). The compound as crystallised from methyl alcohol or acetone has $\alpha = 1{\cdot}465$, $\beta = 1{\cdot}600 \pm 0{\cdot}006$, and $\gamma = 1{\cdot}747$ for λ 5780 A. The optical sign is either positive or negative within the limit of experimental error, as is verified by the lack of curvature of the isogyre in a centred optic axis interference figure. No evidence was found for structural polymorphism, but the possibility was not rigorously eliminated. These constants, which are for crystals of the type shown in Szent-Györgyi's Fig. 2a[2], are published since they are of value in identification of ascorbic acid and since they substantiate Cox's deduction of a plane configuration for the molecule, which is in accord with the accepted furanose ring structure.

STERLING B. HENDRICKS.
Bureau of Chemistry and Soils,
Washington, D.C.
Dec. 10.

[1] NATURE, **130**, 205, Aug. 6, 1932.
[2] *Biochem. J.*, **22**, 1387; 1928.
[3] Note R. W. Herbert, E. L. Hirst, E. G. V. Percival, R. J. W. Reynolds and F. Smith, *J. Chem. Soc.*, 1270; 1933.

Uroflavin, Maltoflavin and Redox-Potentials of Lyochromes

BESIDES hepatoflavin, the isolation of which was described in these columns recently[1], two further members of the lyochrome series have been obtained in a highly purified, though not definitely pure and crystalline state: uroflavin from normal human urine* and maltoflavin from malted barley. The process of preparation is very similar to the procedure adopted for the isolation of hepatoflavin.

Uroflavin as well as maltoflavin exhibit much the same properties as the lyochromes previously described. The yellow-red solutions show a strong green fluorescence. Whereas earlier observations with nickel oxide glass filters suggested that the fluorescence of lyochromes is mainly due to ultra-violet light, it was found by the use of a quartz monochromator that visible light of the blue-violet region and not ultra-violet radiation is responsible for the fluorescence. Both lyochromes yield chloroform soluble 'lumi-flavins' on strong irradiation in alkaline solution. Finally, both pigments lose their colour and fluorescence on reduction and regain these characteristics after reoxidation. The spectrographic examination, for which I am much indebted to Dr. E. R. Holiday, showed that maltoflavin and also uroflavin possess a sharp absorption band in the ultra-violet, the peaks of the band being at 255 mμ and at 281mμ respectively. In contrast to other lyochromes, there seems to be no specific absorption in the range of longer wave-lengths. The absorption curve of hepatoflavin shows two maxima, a sharp one at 258mμ and a flat one around 360mμ.

* Uroflavin is a component of the urochrome fraction, but not identical with urochrome *A* or *B* (cf. [2]).

The potentiometric study of the three lyochromes proves that they represent perfectly stable oxidation-reduction systems. Even in low concentration they impart stable and fairly reproducible potentials to noble metal electrodes within the range of a reasonable redox buffering capacity. As reductants hydrosulphite or palladium-hydrogen, and as oxidants ferricyanide or molecular oxygen, were used. The position of the normal potentials (E'_0, referring to the normal hydrogen electrode) was found as follows: Hepatoflavin: *p*H 5·88, $E'_0 = -0{\cdot}177$ v.; *p*H 7·3, $E'_0 = -0{\cdot}219$ v.; *p*H 8·62, $E'_0 = -0{\cdot}274$ v. Maltoflavin: *p*H 7·4, $E'_0 = -0{\cdot}216$ v. Uroflavin: *p*H 7·2, $E'_0 = -0{\cdot}217$ v. (phosphate buffer of isotonic strength was used throughout). The titration experiments were performed at room temperature (16°–19·5° on different days, constant within 1° during the experiments). The curves obtained so far indicate an electron

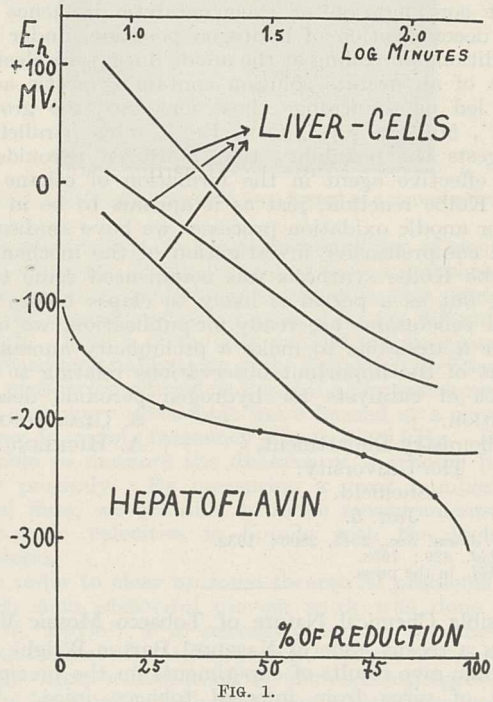

FIG. 1.

number of $n = 1$ rather than of $n = 2$. It should be mentioned that Bierich *et al.*[3], working with a product from mammalian tissues which is probably identical with lumi-flavin[1], report an E'_0 of $-0{\cdot}217$ v. at *p*H 7·2 and of $-0{\cdot}139$ v. at *p*H 5·39, but give index potentials corresponding to $n = 2$.

The physiological significance of the extremely negative position of the normal potentials of these widely distributed biological redox-systems awaits elucidation. Under normal aerobic conditions, if there is such a state as a uniform aerobic reduction potential (which would then be near to $r_H = 12$)[4], the cell flavin would be present entirely in the oxidised state. But around $r_H = 7$ ($E_h = -200$ mv.), which is considered to be the general anaerobic reduction potential of living cells, the cell flavin is exactly in its equilibrium range. This fact is illustrated in Fig. 1, which in its upper part shows an experiment of Clark *et al.*[5], in which the reduction potential of liver suspensions in phosphate buffer at *p*H 7·4 was observed, whilst in the lower part one of our curves

obtained on reduction of hepatoflavin at *p*H 7·3 is given.

Another striking coincidence is represented by the fact that the normal potential of the lactate-pyruvate-enzyme system[6] is almost identical with the normal potential of the flavins at the same *p*H (E_0' being respectively −200 mv. and −219 mv. (hepatoflavin) at *p*H 7). The relation between the flavin potential and the equilibrium conditions in enzyme-substrate systems is under investigation.

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A Camera Method for Charting Quadrats

THE botanical analysis of pastures by means of quadrats should combine both speed and accuracy. Up to the present, the rapid methods have been somewhat subjective, and in many cases the results obtained cannot be compared closely owing to variation in the personal factor. The more intensive objective analyses, on the other hand, have sacrificed speed to greater accuracy. The following method of quadrat charting has accordingly been devised in order to secure both speed and accuracy, and is of special value in the charting of open tufted swards such as those commonly found in South Africa.

The apparatus consists of a wooden square metre quadrat to which is screwed a tressel with an extra leg at each end to secure rigidity. The precise form of this tressel is unimportant; that it should be rigid is all-important. The tressel supports a camera directly over and focused towards the centre of the quadrat. The image of the quadrat is thrown not on to the usual frosted focusing glass, but on to a *sheet of plain glass* upon which is secured a *sheet of transparent (or oiled) squared paper*. The image of the vegetation within the quadrat can then be traced by pencil with ease and accuracy upon the paper.

In using the apparatus, it is desirable to have two workers, one tracing the outline of the plants (basal cover or otherwise), the other moving the foliage of the grass, etc., to render the outlines clear to the tracer, and, if necessary, identifying the species. For ease in working, the light-hood screening the image should fit closely to the top of the camera, and be provided with eye-pieces and an arm-hole at the side. Both vertical and lateral adjustments of the camera are provided for on the frame, but once the correct position is obtained no further adustments are necessary.

The method has several advantages:

(1) The apparatus is readily constructed from simple material. Any half-plate camera can be employed, provided it has a suitable wide-angle short focus lens (approximately 5·4).

(2) The apparatus is collapsible and can be fastened into a small bundle for moving long distances; for short distances, the whole apparatus when set up can be moved with ease.

(3) Once adjusted, no further adjustments are necessary.

(4) Photographs of the charted vegetation may be obtained if necessary by merely substituting the dark slide for the glass plate.

(5) It is both rapid and accurate in use. A tufted sward, composed of a number of different species, can be charted and identified in ten to fifteen minutes.

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Diethyl Peroxide as a Pro-Knock

IN spite of the considerable literature, there seems to be no special reference[1] to the properties of diethyl peroxide as a pro-knock. In view of its possible importance in some theories of hydrocarbon combustion, it was of interest to investigate its behaviour in the engine. Diethyl peroxide is a violent pro-knock, slightly more potent than amyl nitrite at the same concentration. Its knocking action is inhibited by lead ethyl.

Ethyl hydrogen peroxide is likewise definitely a pro-knock. In spite of the ease of thermal decomposition, 30 per cent of hydrogen peroxide was found to have definite, but very slight, pro-knock tendency.

Apart from the possible theoretical significance of these facts, which is being discussed elsewhere, it seems desirable to record the pronounced knocking behaviour of this class of compounds.

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[1] Cf. possibly Withrow and Rassweiler, *J. Ind. Eng. Chem.*, December, 1933.

Three Discharges of Ball Lightning

AT 4.15 p.m. on January 11, the phenomenon of ball lightning occurred at the house of Mr. Joseph M. Wreath, Ballymoney, Co. Antrim.

A first ball exploded against the corner of a metal-bound tea chest just inside the wide open door of a coach-house in a walled-in yard attached to the dwelling-house. A second exploded a minute or two later against a ladder leaning against the same coach-house. A third entered a ground floor room of the dwelling-house, having come down the chimney against the up draught due to a fire burning at the time. It exploded in the fireplace.

The balls outside were seen by Mr. Wreath and a friend, who describe them as orange-red and as being of about the size and having the velocity of a cricket ball. That indoors was seen by two ladies.

A wireless aerial is attached to the chimney stack by which the third ball entered the dwelling-house.

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Research Items

Mohenjo-daro. The Sir George Birdwood memorial lecture of the Royal Society of Arts delivered on December 8 by Dr. E. H. J. Mackay (see NATURE, 132, 960, Dec. 23, 1933) is published in full in the Society's *Journal* of January 5. The objective of the six years' excavation under Dr. Mackay from 1927 to 1933 was to establish the cultural history of the city in the period represented by the lower strata. Attempts were made to reach virgin soil, but these had to be abandoned at a depth of 43 ft. below the surface of the mound owing to the seepage of water from the Indus. The earliest remains of the city must be regarded as irretrievably lost, failing the employment of expensive pumping operations. The city from the earliest times was laid out in rectangular blocks of remarkable accuracy, the streets running at right angles. Excavations have been carried down to six levels of occupation, the finest and most carefully laid masonry being found in the early levels. Houses were well built up to the end of the Intermediate Period, when signs of economy appear and walls were made thinner. Houses were of two or more stories, the upper being reached by brick staircases. The drainage system is the most elaborate of any city of the same date even outside India. In the last two phases, when the wealthier population had left the city owing to floods, houses were roughly built and those of the *DK* mound were occupied by artisans. The city at this time was apparently exposed to raids from hill tribes, as skeletal remains have been found of inhabitants who had suffered a sudden and violent death. The skulls fall into two classes, Mediterranean and proto-Australoid, one showing a Mongolian strain. Cultural affinities with Mesopotamia, the results of trade, point to a date 2750–2500 B.C. for later strata and about three hundred years earlier for the lower levels. The highest art of the people is shown in the cutting of seals, the subjects affording valuable evidence of their religious beliefs. They appear to have been of western Asiatic origin, but there is at present nothing to indicate the date or route of their entry into India.

Jungle-Fowls from the Pacific Islands. The origin of the jungle-fowls of Polynesia, whether from wild individuals imported from Asia or from varieties already domesticated, is uncertain; but, on the whole, the probability lies with the former suggestion. If that be so, then the great variety of the Pacific races, now living in a feral state, must be due to changes which have taken place since the introduction of the wild species, probably long before Wallis and Cook discovered the natives of the Tuamotus and Tahiti using the birds for food, in 1767 and 1769. Stanley C. Ball, in a monograph of the Pacific Islands forms, points out that, compared with the wild *Gallus gallus*, they are on the average considerably larger, and their variation in size greater (*Bull. Bernice P. Bishop Museum*, 108; 1933). Variation appears to have been greater in the Society and Marquesas archipelagos than in Fiji and the New Hebrides. In the western groups, white spotting is the single remarkable variation, whereas the Marquesas has a red strain with feathered tarsi and yellow-backed males, and in the Society Islands, white-backed males, melanic cocks and hens, white-laced hackles, mingle with the wild type. But all the birds, everywhere, are single-combed.

Scottish Tunicates. Dr. Harold Thompson continues his studies of tunicates in his paper "The Tunicates of the Scottish Area, their Classification, Distribution and Ecology. Part 3: Sedentary Tunicata (continued) Order Diktyobranchia" (Fishery Board for Scotland. Sci. Invest. 1932. No. 2; 1933). Mainly based on records from Scotland, the work represents a thorough overhauling of the groups dealt with, which in the present part include the Rhodosomatidæ, Ascidiidæ, Perophoridæ and Cionidæ. In a paper by Lindsay and Thompson (*J. Mar. Biol. Ass.*, 17, 1; 1930) the author has already inquired into the determination of specific characters in the family Ascidiidæ, in which it was suggested that the three recognised genera *Phallusia*, *Ascidia* and *Ascidiella* of Roule might be combined. In the present paper the same combination is kept, and with the genus *Ascidia* are merged both *Ascidiella* and *Phallusia*. There is a very large list of new Scottish records given for *Ascidia scabra* as distinct from *A. aspersa*. Within the order Diktyobranchia there are two species typical of arctic conditions, two of arctic and north boreal conditions, eight typical of boreal conditions and two of south boreal conditions. The boreal species tend to be confined to the Mediterranean and east Atlantic boreal regions, and, with the exception of *Ascidia scabra*, *Ciona intestinalis* and to some extent *Ascidia virginias* and *Ascidia conchilega*, tend to fail in North Sea water proper.

Tidal Bores. In the *Geophysical Supplement* (vol. 3, No. 5) to the *Monthly Notices of the Royal Astronomical Society*, Dr. Vaughan Cornish describes observations made by him on tidal bores on the Severn and Trent. The paper is non-mathematical, but the observations are quantitative, and made with the view of providing data on which can be based an adequate mathematical investigation of the type of bore most characteristic of English and French rivers. In this type the steep slope of the head of the tide breaks up into a group of short waves. In his observations on the Trent, during the years 1922–28, Dr. Cornish observed the same bore at different points up the river, travelling from point to point by motor-car, outstripping the bore. He observed not only the changes in form of the bores when rounding bends, and across points where the river depth changed rapidly, but also in passing the mouth of a canal opening on to the Trent. He urges the need of a co-operative study of the Trent bore, by a group of students equipped with tide-gauges, current meters and kinematographic cameras.

Low Temperatures by Adiabatic Demagnetisation. De Haas, Wiersma and Kramers describe (*Physica*, 1, Dec. 1, 1933) the experiments which have led to the lowest temperatures yet attained. A quantity of a paramagnetic salt is cooled by liquid helium and kept for some time in the field of a large electromagnet. The field is then suddenly reduced, and the demagnetisation of the salt under approximately adiabatic conditions causes its temperature to fall. The specimen is arranged to lie in an inhomogeneous magnetic field and the mechanical force on the specimen is measured by a balance, so that its susceptibility may be determined. The magnetic susceptibility is used to provide a scale of temperature

which is extrapolated below the temperatures measured with liquid helium. The salts used were cerium fluoride and the ethylsulphates of cerium and dysprosium. In an experiment recorded in a footnote potassium chrome alum was used, and gave the lowest temperature—below 0·05° K. (see also NATURE, 132, 372, Sept. 9, 1933).

Oxidation and Condensation of Phenols. The *Proceedings of the Royal Society* of December contains a set of papers by H. G. H. Erdtman on the oxidation and condensation products of phenols. It seems probable that the complicated substances called 'humic acids' possess an aromatic structure and that they are produced by the coupling of quinonoid molecules. The first part of Erdtman's work is the investigation of the reactivity of some simple monocyclic quinones in the light of Lapworth and Robinson's application of the electron theory of valency. According to this theory, the reactivity of unsaturated molecules may be explained in terms of the 'polarisation' of parts of the structure. The reaction studied experimentally was the acetylation of the quinines with a mixture of acetic anhydride and sulphuric acid, and the reactivity of the various quinones showed a fairly good agreement with the predictions of the theory. The theory also suggests a mechanism for the coupling of carbocyclic rings during the oxidation (dehydrogenation) of phenols. A typical example is the formation of a hexahydroxydiphenyl on the oxidation of pyrogallol in baryta solution, and a whole series of such couplings was investigated. During the work, an investigation of the polymerisation of toluquinine led to the discovery of a termolecular condensation product, and a termolecular product was also obtained from benzoquinine, though in this case further polymerisation leads to a poor yield; α-naphthaquinone yields more crystalline termolecular product than toluquinine.

Medieval Glass. Very little information is available on the chemical composition of medieval glass, although this is obviously an important criterion of the genuine nature of particular specimens. A detailed account by M. Chesneau (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, 132, 609; 1933) of the chemical analyses of French window glasses of the twelfth and thirteenth centuries is therefore of considerable interest. These glasses contain less silica and more alkali (potash and soda) and alkaline earths (lime and magnesia) than modern glass, the mean percentages being 70 per cent silica, 17 of alkali (soda) and 13 of lime, and are therefore more fusible and more easily attacked by moisture and atmospheric carbon dioxide, although the actual specimens were well preserved. The addition of common salt during fusion, as mentioned by Agricola, is considered probable, since the proportion of soda to potash in the glasses is larger than could be accounted for by the use of wood ashes alone, as specified by Theophilus. The probable method of working is fully described, the glass being first blown, and the pear either pierced and spun or worked into a cylinder, afterwards cut and opened out. The glass had been decolourised by addition of pyrolusite and the colours were due to metallic oxides, the red glass, however, being formed by a thin sheet of red superposed on or interposed between colourless glass. The red was coloured with cuprous oxide; the blue with cobalt with traces of cupric oxide and having a grey tone owing to the presence of nickel; the yellow contained antimony oxysulphide with some ferric oxide; the violet had oxide of manganese (pyrolusite) together with some ferric oxide, giving the flesh tint of all ancient violet glasses; and the green contained cupric oxide. The cobalt mineral in all probability came from Saxony, the other minerals being native in France.

Transient Waves on Transmission Lines. The importance of preserving the best possible continuity of supply on electric transmission lines has led engineers to study the effects produced on them by transient or 'travelling wave' phenomena. A great many experimental and theoretical researches particularly in the United States have now been published on this subject. The waves are caused mainly by lightning, but sometimes a fault connecting the line to the earth by an arc, or even switching operations will cause them. In a paper read to the Institution of Electrical Engineers on January 4 by Dr. J. L. Miller, the influence of these waves on electrical devices is discussed. Dr. Miller states that lightning is practically always the cause of dangerous over voltages. American experimenters have shown that lightning surges can cause a pressure rise of about seven or eight times the normal voltage. In one particular case careful records were kept of the disturbances occurring on five different transmission lines over a period of five years. It was found that one per cent reached fifteen times normal line voltage, five per cent reached eleven times normal line voltage and ten per cent reached eight times this voltage. Altogether, nearly 700 surges were recorded and 73 of them were more than eight times normal. It is concluded that a line at the British grid pressure of 132 kilovolts would, if placed in this district, be liable to three surges per annum of the order of a million kilovolts. It will be seen that transformers and other electric devices would have to operate under dangerous conditions. An oscillogram has been obtained which shows a surge which rose to five million volts in less than two microseconds. The author gives a fairly complete mathematical theory and checks it by showing high-speed cathode ray oscillograms of the phenomena. He has explored a very wide field about which opinion is still divided.

The Support of the Chromosphere. A novel theory of the manner in which the chromosphere is supported has been put forward by Dr. S. Chandrasekhar (*Mon. Not. R.A.S.*, 94, No. 1, November 1933). The difficulty of accounting for the enormous extension of the chromosphere was first met by Prof. E. A. Milne, who suggested that the calcium atoms were supported by selective radiation pressure. It has also been suggested that turbulence is a cause of the behaviour of the chromosphere. Dr. Chandrasekhar has extended Milne's theory in a very interesting way. Guided by the observed granular appearance of the solar disc, he discards the notion of hydrostatic equilibrium, and introduces instead the hypothesis that the chromosphere is in a hydrodynamically steady state. The mean flux of radiation corresponds to full support of the chromosphere, and atoms over bright areas are accelerated outwards, while those over the darker patches tend to fall back. The theory predicts for the outward march of the density gradient a law which keeps numerically close to an exponential law.

Elementary Science in Secondary Schools

IN a consideration of the School Certificate Examination, the Panel of Investigators appointed by the Secondary School Examinations Council reported in 1932* that so far as science is concerned, the examination was unsatisfactory. There are fifteen possible ways that a candidate for School Certificate may be examined in science, no examining body having less than five possibilities. By taking advantage of the possibilities offered, a candidate may under some examining bodies offer for a science pass in School Certificate, either heat, light and sound, or magnetism and electricity, without any other science subject. While this is possible in only three out of the eight examining bodies, in all cases a candidate need only offer one science, usually chemistry, physics or botany, in order to pass in science. The concentration thus demanded on a single science subject in the school examination is not regarded as in the best interests of the pupil or of science, in that it is impossible to achieve any satisfactory training in scientific method by a consideration of any one single science, and that also such a procedure does not give to the pupil a sufficiently comprehensive idea of what is connoted by the term 'science'.

These disadvantages, to which the Panel of Investigation directed attention, have been realised by some examining bodies, and attempts have been made to suggest broader conceptions of science in examinational syllabuses. Thus general physics, physics cum chemistry (under various names), biology, and general science have been introduced as alternative papers. The general physics paper is a purely qualitative paper, covering superficially almost the same ground as the normal physics paper; the physics cum chemistry paper is usually resolvable into a "test on a little chemistry plus a truncated course in physics"; the biology, while obviously a better introduction to life sciences than either the single subjects of botany or zoology, is usually tested by a paper divided into two sections, one botanical and the other zoological, "with little to suggest that the paper is dealing with the phenomena of living things as a whole". The most successful has been the general science paper, which, however, has been subjected to the criticism of superficiality.

These particular criticisms are made by the Investigators as a corollary to their general criticism of the connexion between School Certificate and Matriculation. The original intentions† of the School Certificate Examination were to "test the results of the course of general education", and to be suitable for forms in which the average age of the pupils ranges from about 16 years to 16 years 8 months, and that "the standard for a pass will be such as may be expected from pupils of reasonable industry and ordinary intelligence in an efficient secondary school"; and it was only intended secondarily to act as a qualifying examination for entrance to universities. There is no doubt, however, that these original intentions have become obscured, and the university entrance qualification has become predominant, Matriculation being regarded as a superior kind of School Certificate by both candidates and employers. The Investigators note the number of students entering universities from State-aided secondary schools in England and Wales in 1930–31 as 4,132, whereas the number of candidates who qualified for matriculation in the School Certificate examinations conducted by London and the Northern Joint Board in July and December, 1931, was 11,119; in other words, considering all possibilities, not more than one in four of the pupils in State-aided schools who "matriculate actually proceed to a University". Hence arises the much condemned university domination of the secondary school curriculum.

These lines of criticism of the secondary school examinations agree with the new tendency of the secondary school to regard its pupils as potential citizens and laymen, and not necessarily as potential specialists in science or any other subject. In other words, the modern secondary school is beginning to face towards the practical world of the ordinary citizen and away from the necessarily narrow academicism of the university specialist. The secondary school curriculum is being recast to bring it in line with the requirements of intelligent laymen living in a modern world.

This broadening tendency is making itself most manifest in the school science syllabuses. Thus it was agreed at the annual meeting of the Science Masters' Association on January 4 "That there is a general body of scientific knowledge not confined to either of the special fields of the physical and biological science which ought to be known both by the ordinary citizen and by those who may ultimately specialise in some corner of one of these two fields". This broader aspect of science is being termed 'Elementary Science' in order to avoid confusion with existing syllabuses designated 'General Science' and 'General Elementary Science', which, although an approach in the required direction, suffer from certain defects, criticisms, and traditions that it is hoped 'Elementary Science' may avoid.

A sub-committee of the Science Masters' Association in a recent report, defines 'Elementary Science' as "a method of presenting the fundamental principles of science based on the interpretation to youth of the world in which he lives, involving not only an understanding of these fundamental principles, but also of the attitude and method of science generally. Science is here regarded as a living whole, comprehending all the sectional sciences necessary to give youth an intelligent understanding of his biological, chemical and physical surroundings".

It is emphasised that the value of such science to the pupil lies not only in a wide appreciation of his biological, chemical and physical environment, but also in an understanding of the characteristic attitude and methods of the scientific worker. Moreover, 'Elementary Science' places the needs of the pupils before the demands of any sectional science; its essence lies not so much in the syllabus, the content of which must be selected and organised according to the actual environment and needs of the pupils, as in the interpretation of it as a method of explaining that environment. Its content must, of course, include the three fundamental sciences of biology, chemistry and physics, but the proportions of each are determined not by their relative importance as

* The School Certificate Examination. (H.M. Stationery Office, 1932.) See NATURE, 131, 217, Feb. 18, 1933.

† Board of Education Circular 849 and subsequent circulars.

sciences, but by the extent to which they each contribute to the environment.

In order to meet the criticism of superficiality and triviality to which all broad schemes of science teaching are subject, the sub-committee referred to has drawn up not only a suggested syllabus, but also a list of fundamental principles of science, the application of which is of fundamental importance in the life of the ordinary citizen, and towards a knowledge of which it is felt that any course of elementary science, whatever its content, should aim. These fundamental principles presented as the aims of the new subject need, and it is hoped will get, criticism and correction by scientific workers, laymen and all interested in educational matters.

It is realised, too, that there are many practical difficulties of method, organisation and teaching, particularly where teachers are by their training of necessity specialists; but it is felt that with a clear statement of aim and policy, these difficulties will not be insuperable.

What is more controversial is the recommendation of the Investigators, which was agreed to by the Science Masters' Association at the annual general meeting, to make an examination in this subject of elementary science compulsory for all School Certificate candidates, unless they offer all three science subjects, biology, chemistry, physics. But it is felt that, while no brief is held for examinations, as such, so long as they exist they do largely influence the curriculum of the schools, and unless the subject of elementary science, like English and mathematics, is made compulsory, it will not receive serious consideration in competition with other subjects of examinational value. Moreover, much as compulsion is disliked, it is pointed out that compulsion for the science candidate virtually exists at the moment, but confined to a very narrow field of one science, or part of one science. The result of the adoption of compulsory elementary science in School Certificate would broaden both the examination and the school curriculum and thus be of most benefit to what, after all, should be the paramount consideration—the needs of the ordinary pupil. F. W. TURNER.

Patents and Inventions

THE Institution of Mechanical Engineers has recently formed an Inventions Advisory Committee with Mr. W. Taylor as chairman. In connexion with the inauguration of this Committee, on January 26 a meeting of the Institution was held when four short papers were read dealing with invention and inventors. These papers were "The Evolution of Invention", by H. W. Dickinson; "The Inventor", by Dr. H. S. Hatfield; "Provisional Patent Protection and Patent Claims", by Sir William Jarratt and "The Development and Exploitation of Inventions", by A. H. Gledhill.

The subject is a vast one, for as Mr. Dickinson said, "All social, economic, physical, technical, and commercial developments are the result of invention, and we may say that civilization is a synthesis of the inventions made by man since his appearance on this planet a million years ago". The word invention to-day has three meanings: (1) the thing schemed or contrived; (2) the mental processes involved; and (3) the ability to evolve the new scheme or contrivance, commonly called inventiveness. As regards the encouragement of invention, England furnishes the first known instance of encouragement being given to the producer of a new process, for in 1440 (18, Henry VI) Letters Patent were granted by the Crown to John of Schiedam and his company for a method or process of manufacturing salt. It was, however, the Statue of Monopolies of 1624 which formed the basis of our present patent systems.

Dr. Hatfield seems to consider the technical inventor to be a new figure in the history of mankind, but it is doubtful whether this view is correct. The ships, the aqueducts, the tunnels and the buildings of the Romans were the result of the accumulated inventions of the day, and these would have undoubtedly been followed by others had not the Empire been overwhelmed by the barbarians of the north. In concluding his contribution to the symposium, Dr. Hatfield attempted to define the mental characteristics which distinguish the successful inventor.

While the papers of Mr. Dickinson and Dr. Hatfield referred largely to the philosophy of invention, those by Sir William Jarratt and Mr. Gledhill discussed the position of the inventor and of patent legislation to-day. Sir William Jarratt congratulated the Institution on the formation of a Standing Committee to consider inventions submitted by members. Some years ago, he said, he served on a committee appointed to consider the best method of dealing with inventions made by Government servants, and through the report of that committee each of the great Departments of State has now an Awards Committee, with power to recommend monetary awards for inventors. If industry in Great Britain is to maintain and improve its position in the world, it will be necessary that discovery and invention shall continue to be encouraged by public and private benevolence, by research scholarships, by a sound system of patents and by the work of committees such as that of the Institution of Mechanical Engineers.

The last paper, that by Mr. Gledhill, dealt concisely with the commercial development of inventions, the sale of the products of an invention and the manufacturing of the product of an invention. Incidentally, he mentioned that the Patent Office made a net profit of £146,000 last year, and he suggested that a portion of this might wisely be used to encourage developments of inventions which would benefit the country. It might also be proposed that some of this profit be used to improve the conditions under which the examiners work and for the upkeep of the library, where many books are in need of rebinding and where a system of vacuum cleaning would be advantageous. It may indeed be doubted whether an increase in the facilities for inventors and a reduction of their fees is not a sounder national policy than to look to the Patent Office as a source of revenue.

That there is a need for a continual revision of the patent laws was suggested by several of those who took part in the discussion of the papers. The general interest shown in the discussion is a good augury for a new departure of the Institution, which as the chairman, Col. A. E. Davidson, said, is justified by its Royal Charter, which states that one object of the Institution is "to encourage invention and research in matters connected with mechanical engineering".

The Piezo-Electric Loud-Speaker

MODERN broadcasting receivers tend to give an undue response to the lower audio frequencies, and in the majority of cases the range is limited to frequencies below 5,000 cycles per second. This is partly due to the fact that the lower frequencies, which at one time were not reproduced very well, have now become attractive as lending power and tone to the reproduction, but it is also due to the demand for increased range in distant reception, for which purpose a high selectivity is required, a virtue which is most easily attained by reducing or eliminating the higher frequencies. Compensation for this latter deficiency can be obtained to some extent by using tone-correcting arrangements in the audio-frequency stages of the receiver, but the effect of these in the sound reproduction is rather handicapped by the poor response of the moving-coil type of loud-speaker to the higher audio-frequencies.

A solution of this difficulty is now in view in the form of the piezo-electric loud-speaker, an investigation of which has been described in a paper by Stuart Ballantine, of the Boonton Research Corporation, U.S.A., published in the *Proceedings of the Institute of Radio Engineers* of October 1933. The loud-speaker employed in these measurements was of the horn type and was driven by a piezo-electrically active diaphragm built up of crystals of Rochelle salt (sodium potassium tartrate), prepared by the Brush Development Company of Cleveland, Ohio. The diaphragm is formed of four pairs of crystal plates, the plates of each pair being so cut that they move in opposite directions under the influence of an electromotive force. The opposite faces of such a pair of plates are cemented together, and the combination, when clamped along one edge, tends to twist on the application of a potential difference to its foil electrodes. Four such units are cemented together to form a flat square diaphragm, which is clamped around its periphery, so that in use the centre portion or junction of the four units vibrates normally to the plane of the assembly, and in synchronism with the audio frequency electromotive force applied to the metal foil electrodes.

The characteristic of this type of loud-speaker, that is, the relation of output sound pressure to frequency, can be controlled to some extent by the electrical circuit in which it is used and also by the resonant frequency of the crystal diaphragm, which depends upon its dimensions. In an example illustrated in the above paper, the sound pressure rises fairly uniformly with frequency from about 1,000 cycles per second to the resonant value at 8,000 cycles per second. This characteristic may be partially levelled off by suitably connecting it to an electrical circuit; and in a second case in which the loud-speaker was fed through a transformer in series with an inductance, the sound output, after increasing rapidly between frequencies of 1,000 and 2,000 cycles per second, remained sensibly uniform for higher frequencies up to 10,000 cycles per second. This type of response immediately suggests the possibilities of a combination of a piezo-electric loud-speaker with one of the moving-coil type, in which the output is moderately constant for low frequencies but falls rapidly above the cut-off frequency. Ballantine describes such a combination using a moving-coil loud-speaker which has been designed for uniform reproduction up to 3,000 cycles per second, with a rapidly falling response above that frequency. The combined output is shown to be approximately uniform at all frequencies between 60 and 9,000 cycles per second. Such dual arrangements have the advantage that the response can be limited to that of the low-frequency member of the pair if considerations of noise or transmission interference make this desirable.

The piezo-electric loud-speaker also forms the subject of an article in the *Wireless World* of January 5, in which the development in Great Britain, by the Rothermel Corporation Ltd., is briefly described and illustrated. In this case the crystal unit is built up of four laminations, approximately $2\frac{1}{2}$ in. square, the total thickness being $\frac{1}{4}$ in. Three of the corners of this assembly are clamped between rubber blocks, and the vibration of the fourth corner is used to drive the cone diaphragm. The equivalent capacity of this unit is of the order of 0·03 mfd., and it is suitable for use in conjunction with an ordinary moving-coil output transformer. The efficiency of the unit appears to be very good, particularly in the frequency range 2,000–8,000 cycles per second; while in combination with a standard type of permanent moving-coil loud-speaker the quality of reproduction is claimed to be superior to that hitherto obtained with commercial dual moving-coil units.

Larval Crabs from Japan*

DR. HIROAKI AIKAWA has recently supplemented his first paper on the newly-hatched crab zoeas of Japan (1929) with one on the intermediate (later zoeal) stages between the first zoea and the megalopa. Crab zoeas of all kinds are very common in the Japanese plankton, but few of them have been traced to the adults, and the author has devised a distinctly helpful scheme for placing them in groups characterised by definite features. Recent research by other workers has shown that there are several larval characters by means of which the various natural divisions can be recognised; the Oxyrhyncha can be divided from the Brachyrhyncha and many of the families and genera can be identified, whilst by rearing the individuals several species are now known throughout the whole life-history. The Dromiacea always stand apart and should certainly be separated from the Brachyura.

The most important features which can be used in classification are the number of spines on the carapace, the form of the antennæ and the number and position of the spines on the telson. Dr. Aikawa uses the position on the body of the main chromatophores, but these are no good in long-preserved material. Besides elaborating the classification of

* *Records of Oceanographic Works in Japan*, **5**, No. 2, June 1933. "On Larval Forms of Some Brachyura". (2): "A Note on Indeterminable Zoeas", by Hiroaki Aikawa.

the antennæ and telson, he now adds the establishment of a hair formula for the endopodite of the two maxillæ and of the second maxillipede and of the joints of the latter, which he finds are constant for the species through all the zoeal stages. He has established nine groups of zoeas based on the form of the antennæ and telson by the aid of which any unknown zoea of any stage may be classified approximately, but the classification is admittedly not a natural one. For example, the group Inachizoea is typical for the Inachidæ, but also contains *Pilumnus*, *Heteropanope* and *Gonoplax*, whilst the group Grapsizoea, although one type is chiefly confined to the grapsoid crabs, contains another type in which are included many of the Portunidæ, also *Thia*, *Eriphia*, *Hyas* and *Maia*; nevertheless, with the further and more exact descriptions of the individual zoeas, one can get a very good idea of their probable position in a natural classification and comparing it with those the adults of which are known, many genera can already be identified.

The system of groups here given is to be regarded as a kind of key which is really helpful and a distinct step forward in the elucidation of the difficult brachyuran larvæ. Several zoeas are described and figured, none of which can be actually referred to any known species, but they are classified into these groups. It is possible, however, from the characters given to place them at least in the families if not in the genera to which they belong.

It is hoped that in the near future the author will produce a similar grouping for the megalopæ, which is much wanted.

University and Educational Intelligence

CAMBRIDGE.—Prof. Werner Heisenberg, of the University of Leipzig and Magdalen College, Oxford, has been appointed Rouse Ball lecturer for the year 1933–34.

At Queens' College, Prof. James B. Buxton, professor of animal pathology in the University, has been elected to a professorial fellowship.

LONDON.—The University is making a grant of £100 towards the fund for the purchase of the "Codex Sinaiticus".

A course of six lectures on cytology will be given at University College, Gower Street, London, W.C.1, on Wednesdays commencing on February 7, at 5 p.m. by Dr. R. J. Ludford, Dr. E. S. Horning and Dr. K. C. Richardson. The lectures are open to the public.

OXFORD.—On Tuesday, January 23, Congregation approved an amending Statute for defining more exactly the scope of the Hope professorship of zoology, by adding ("Entomology") to the designation of the professorship, and to the mention of "zoology" wherever it occurs in the statement of the professor's duties.

At the same meeting of Congregation, the Master of Balliol, in moving the preamble of a statute for extending and improving the provisions for the study of forestry in the University, directed attention to the fact that the clauses of the statute, if they were deemed unacceptable, were open to revision by amendment at a later stage. The same point was urged by Dr. N. V. Sidgwick. Prof. F. A. Lindemann, though refraining from opposing the passing of the preamble, thought that the statute in its present form provided no sufficient guarantee for ensuring the permanence of grants. The preamble was carried without a division.

Prof. W. G. Le Gros Clark, professor of anatomy at St. Thomas's Hospital Medical School, University of London, has been appointed Dr. Lee's professor of anatomy.

On Tuesday, January 30, Congregation approved the preamble of a statute establishing a statutory readership in physical anthropology. The Senior Proctor, Mr. H. G. Hanbury, of Lincoln College, explained that the duties of the post had been voluntarily undertaken by the former Lee's professor of anatomy; and that the present measure was called for in consequence of the recent retirement of Dr. Arthur Thomson from the professorship.

The honorary degree of M.A. was conferred on Miss Ethel Bellamy in recognition of her work at the University Observatory on the photographic chart of the heavens.

Science News a Century Ago

The King's Speech, 1834

February 4, 1834, saw the opening of Parliament, and amongst the items dealt with in the Speech from the Throne (Earl Grey, Prime Minister) was a mention of the Act passed in the previous session abolishing slavery under the British flag. Legislation dealing with the status and power of municipal corporations was forecast (but was not passed until 1835). The Speech lamented the continued distress amongst the proprietors and occupiers of land, and Parliament was recommended to give early consideration to such a final adjustment of the tithes as may extinguish all just causes of complaint. On the subject of Ireland the Speech contained the following passage: "But I have seen with feelings of deep regret and just indignation the continuance of attempts to excite the people of that country to demand a repeal of the legislative union".

Porcupine Men

During January 1834, a middle-aged man, of very athletic and robust form of body, completely covered with a green horny substance in the form of quills, not dissimilar to those which are produced on the porcupine, presented himself at the Westminster Hospital for exhibition. The parts which had escaped the deformity were his face, the palms of his hands and the soles of his feet; every other part of his person was abundantly supplied with this green horny substance. He stated that he shed his horns, or quills, annually, and a fresh crop succeeded.

A description of the case appears in the *London Medical and Surgical Journal* of February 6, 1834. The man was a member of the celebrated Lambert family, in which this remarkable condition, an extraordinarily scarce form of the skin disease named ichthyosis hystrix, was present in at least six generations. In every case the condition appeared about two months after birth and affected the males only. The case of the first member of the Lambert family to be affected was reported to the Royal Society on March 16, 1731, by John Machin, the secretary, and Prof. Gresh (*Phil. Trans.*, 38, 299; 1731) at fourteen years of age, and in 1755 at the age of thirty-eight with his son Edward by Baker

(*ibid.*, 49, 21; 1755). Edward and his two sons, who all presented a similar skin condition, visited Germany and France, where they were described under the name of "Porcupine Men" by Blumenbach, Autenrieth and Tilesius. Other members of the family similarly affected were afterwards described by Elliotson in 1831, Pettigrew in 1834 (in the subject of this note) and by Pickells in 1851. Further details concerning the Lambert family, including a reproduction of the figure published in 1802 by Tilesius, will be found in E. A. Cockayne's "Inherited Anomalies of the Skin and its Appendages" (1933), pp. 182–85, from which most of the above information is taken.

The Franklin Institute

At the beginning of the nineteenth century, Philadelphia was the centre of scientific culture in the United States. The American Philosophical Society had been founded in 1769, with Franklin as its first president, while in 1814 and 1824 respectively, the Academy of National Sciences of Philadelphia, and the Franklin Institute of Pennsylvania were inaugurated. The latter society had its birth at a meeting held in the County Court House on February 5, 1824, when it was resolved that "it is expedient to form a Society for the promotion of the useful arts in Philadelphia, by extending a knowledge of Mechanical Science to its members and others at a cheap rate". It was also resolved to attain this object by means of lectures, the formation of collections and of a library and the award of premiums for inventions. The Institute held its first public exhibition in October 1824, its first hall was erected in 1825, and the following year the *Franklin Journal* was established. Two years later this was renamed the *Journal of the Franklin Institute*, by which title it has since been known.

From the first the *Journal* contained original contributions, reprints from other periodicals, reports of committees and notices of American inventions. The annual report of the Board of Managers submitted in January 1834 was signed by Alex. Dallas Bache. At that time there were 1,659 members, and "the condition of the Institution was one well deserving mutual congratulations. From a small beginning, in an attempt to diffuse useful knowledge, to promote practical science and the mechanic arts, the institution had grown to be respected by her members and the public". The report refers to courses of lectures by Prof. J. K. Mitchell on chemistry, by Prof. W. R. Johnson on natural philosophy and by Gouverneur Emerson, M.D., on meteorology. Thanks were expressed to these lecturers and also "to J. Millington, Esq., late Professor of Natural Philosophy in the Royal Institution of London who is engaged on a most able series of lectures on astronomy". The society at that time was investigating the principles of water wheels, inquiring into the causes of the numerous explosion of boilers in American steam-boats, and the *Journal* for 1833 and 1834 contains reports of various individuals into the system of weights and measures of the United States, England and France. Its important work in this direction was recognised by the Pennsylvanian Government, and on the instructions of the House of Representatives the secretary of the Commonwealth had forwarded to the Institute a draft of a bill relating to weights and measures for its consideration.

Societies and Academies

London

Royal Society, January 25. A. Zoond and J. Eyre. Studies in reptilian colour response. (1) The bionomics and physiology of the pigmentary activity of the chameleon. In strong diffuse daylight chameleons become dark on a black background and pale on a white one. Blind animals darken in the light. This response depends upon the integrity of spinal reflex arcs. The time relations of these responses have been determined. The threshold for the retinal photoreceptors is lower than for the dermal ones. In weak light the white background response is reversed, the animals becoming dark. Low temperatures above 0° C. have no effect upon the normal response of chameleons to darkness. A theory of nervous co-ordination is developed. It is suggested that the 'daily rhythm' of colour changes may be interpreted in terms of the white background response in strong and weak light, without reference to temperature. A. Wolsky and J. S. Huxley: The structure and development of normal and mutant eyes in *Gammarus chevreuxi*. The eyes of 'eye-colour mutants' ('red', 'no-white', etc.) differ from normals only in pigmentation and not in structure. The eyes of eye-structure' mutants ('albino', 'colourless') are markedly deficient as compared with normal. For the development of normal eyes, the results of Schatz (1929) are confirmed. The differentiation and growth of the optic tract (not previously studied in *Gammarus*) is centrifugal in time: the medulla externa and lamina ganglionaris are at first small, but eventually constitute a large and distinct protuberance. In the eye-structure mutants the adult optic tract is comparable with the early embryonic stage of normals. The structure of albino and colourless eyes can be formally explained in terms of (*a*) a rate-gene causing a delay in differentiation of the organs (optic tract and eye-mass) derived from the primary optic disc; (*b*) a graded distribution of the inhibitory effect caused by this delay; and (*c*) possibly, the consequent absence of a formative stimulus normally exerted by the optic tract upon the differentiation of the eye proper. J. Needham, C. H. Waddington, and Dorothy M. Needham: Physico-chemical experiments on the amphibian organiser. The induction of a secondary embryonic axis in amphibian gastrulæ can be accomplished by the implantation of (*a*) cell-free extracts of the neurula, (*b*) ether and petrol-ether extracts of the neurula, (*c*) adult amphibian tissues, (*d*) ether extracts of adult amphibian viscera. A distinction is made between two factors in induction; the production of an embryonic axis as such, which is called evocation; and the determination of the regional, for example, antero-posterior, character of that axis, which is called individuation. The evocator is probably a definite chemical substance soluble in ether and petrol-ether.

Paris

Academy of Sciences, December 18[1] (*C.R.*, 197, 1545–1705). Louis Cartan: The displacement in an electrostatic field of magneto-electronic spirals. N. Thon: The direct determination of the number of active centres on a crystalline metallic cathode. E. Guillermet: The electrolysis of cupric chloride in methyl alcohol solution. The primary reaction appears to be production of cuprous chloride and chlorine. R. de Mallemann and H. Courtillot: Elliptical

reflection at normal incidence on a transparent anisotropic body. The superficial double refraction of Iceland spar. ANTOINE GOLDET: The thermal variation of the magnetic double refraction of nitrobenzene, benzene and carbon disulphide. The experimental results are given as curves, and are compared with those predicted by the theories of Langevin and of R. de Mallemann. TSAÏ BELLING: The magnetic double refraction of gaseous oxygen. Experiments carried out with a field of 45,000 gauss show that compressed oxygen under the action of the magnetic field clearly acquires a negative double refraction proportional to the pressure. J. J. TRILLAT: Study of the fatty esters of cellulose by means of the X-rays. The reticular distances are a linear function of the number of carbon atoms in the esterifying acid. HUBERT GARRIGUE: The activity of materials exposed to the natural electric field. G. GAMOW and S. ROSENBLUM: The effective diameters of the radioactive nuclei. F. JOLIOT: An experimental proof of the annihilation of positive electrons. The experiments show that when positive electrons are absorbed by matter, there is observed an emission of photons of energy about $0{\cdot}5 \times 10^6$ ev. Hence it is concluded that the process of annihilation of positive electrons imagined by Dirac is confirmed by these experiments. FRANCIS PERRIN: The possibility of the emission of neutral particles of intrinsic mass zero in β radioactivity. W. M. ELSASSER and K. GUGGENHEIMER: The anomalies in the proportion of the elements and on the origin of the radioactive bodies. JEAN THIBAUD: The annihilation of positrons in contact with matter and the resulting radiation. PAUL MONDAIN MONVAL and MLLE. HÉLÈNE SCHLEGEL: The partially miscible pair aniline-water. Study of the inversion of density of the two layers: below 77° C. the aniline layer is the lower, but above this temperature it is the layer rich in aniline which is uppermost. RENÉ PÂRIS: The ternary magnesium-zinc-calcium alloys. PIERRE BRUN: The volume variations of mixtures of water, ethyl alcohol, ether. Additional evidence is given in support of the view previously put forward by the author that the idea of continuity could be extended to the case of the miscibility of liquids. V. AUGER: The existence of pyro- and meta-arsenic acids. Contrary to the views of Rosenheim and Antelman, the author holds that ortho-, pyro- and meta-arsenic acids have so far not been obtained. ANDRÉ MORETTE: The action of vanadium tetrachloride upon some anhydrous chlorides. HENRI MOUREU and PAUL ROCQUET: The product resulting from the action of ammonia on phosphorus pentachloride. The products of the reaction were ammonium chloride, separated by extraction with liquid ammonia, and phosphorus diimidoamide, $P(NH)_2NH_2$. This gives phospham, PN_2H, on prolonged heating in a vacuum at 350°. G. GIRE: Basic sulphate of nickel. L. PIAUX: The Raman spectra of some cyclanones. MLLE. DARMON: The isomerisation of the methyl and ethyl ethers of phenylglycide. G. LEJEUNE: Some tartromanganic salts. R. PAUL: δ-Oxyvaleraldehyde. WIEMANN: The duality of Charon's dipropenylglycol. Preparation of one of the constituents in the crystallised state. R. CORNUBERT and M. DE DEMO: The possible existence of three αα′-dibenzylcyclohexanones. ANTOINE WILLEMART: Isomeric transformations of the hydrocarbons $C_{42}H_{30}$, isomers of the 1 : 3 : 1′ : 3′-tetraphenyl-1 : 1′-rubenes. Description of a new isomer. Splitting up by oxidation. CHARLES PRÉVOST: The halogen-silver complexes of the carboxylic acids. C. ARAMBOURG: The pre-Tertiary formations of the western border of Lake Rodolphe (Eastern Africa). MLLE. D. LE MAITRE: The age of the Chaudefonds (Maine-et-Loire) limestone. G. BORGNIEZ: The possibility of the existence of periods with a desert climate in the central region of the Belgian Congo. MAURICE BLUMENTHAL: The autochtony of the Penibetic in the province of Cadix (Andalusia). ROBERT LAFFITTE: The continental formations of the Tertiary of Aurès (Algeria). A. VINOGRADOV: The elementary chemical composition of living organisms and the periodic system of the chemical elements. Discussion of the relation between the quantity of atoms of a chemical element found in living material and the atomic number of this element. A. GRUVEL and W. BESNARD: Researches on the nature of the sea floor of the western coast of Morocco between Cape Cantin and Cape Ghir. HENRY HUBERT: The aerial currents in Cochin China. C. E. BRAZIER and EBLÉ: The temperature of the air in the neighbourhood of the soil. The ordinary method of taking ground temperature is shown to be defective: details of an improved method are given. P. IDRAC: The influence of the *Mistral* and of the east wind on the temperature of the submarine layers on the Côte d'Azur. R. GUIZONNIER: Phase of the semi-diurnal component of the gradient of electric potential. G. GRENET: The electrical conductivity of the air at Mont-Dore in August 1933. The mean electrical conductivity observed was about double that usually observed elsewhere. The altitude is insufficient to explain this result and the most probable cause would appear to be the hot springs near by and the enclosed form of the valley. G. DAUZÈRE: The spots most frequently struck by lightning in the Department of Aveyron. PIERRE CHOUARD: The intervention of the epidermis in the formation of small bulbs on the green leaves of the Liliaceæ. H. COLIN and E. GUÉGUEN: The floridoside in the Florideæ. Floridoside, containing a molecule of glycerol and one of α-galactose, previously isolated from *Rhodymenia palmata*, is now proved to be present in a large number of Algæ. MME. HUREL-PY: The possibility of dehydrating the vacuoles of the pollen of *Nicotiana Alata*. E. and H. BIANCANI and A. DOGNON: The intervention of thermal phenomena in the biological action of ultra-sounds. E. LEDERER: The carotenoids of a red yeast, *Torula rubra*. Four substances are present in this colouring matter, two of which have been isolated; one is β-carotene, the other a new pigment, torulene. E. FLEURENT: The genetics of wheat and the process of bread-making. M. LEMOIGNE and R. DESVEAUX: The influence of the origin of the microbial strains on the balance of nitrogen capable of determination by Kjeldahl's method in aerobic cultures. CH. HRUŠKA: Vaccination against the *rouget* of pigs with the non-attenuated bacillus. G. RAMON and MLLE. B. ERBER: The presence of the diphtheric antitoxin, of natural origin, in the monkey. MAX ARON: The presence, in the urine of subjects with malignant tumour, of a principle capable of acting on the suprarenal cortex.

[1] Continued from p. 151.

MELBOURNE

Royal Society of Victoria, October 12. GERALD F. HILL: Australian hemitermes (Isoptera), with descriptions of new species and hitherto undescribed

castes. This paper contains descriptions of the winged adults of *Hamitermes neogermanus*, Hill, and *H. meridionalis*, Froggatt, which were previously known from sterile castes only, and of eight new species. W. J. HARRIS and D. E. THOMAS: Geological structure of the Lower Ordovician rocks of eastern Talbot, Victoria. The paper deals with the eastern half of the county of Talbot in central Victoria, extending from Castlemaine and Maldon in the north to Kyneton and Daylesford in the south. The physiography of the area is discussed, particularly as modified by the lava flows usually referred to as the Newer Basalt. A large number of new graptolite localities are recorded and the graptolite zones of the Lower Ordovician rocks have been mapped over about 1,000 square miles. The main structural lines in the area trend a little to the west of north and an anticlinorium extending from Maldon to Dean occurs in the west with its eastern limb truncated by the Muckleford fault. East of this is the Guildford-Bullarto synclinorium, and the Chewton-Lyonville anticlinorium, and, after a smaller intervening synclinorium, the Taradale-Lauriston anticlinorium. The relation of gold occurrences to geological structure is briefly discussed.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, February 5

UNIVERSITY COLLEGE, LONDON, at 5.30.—L. W. G. Malcolm: "Africa, Past and Present".*

SOCIETY OF ENGINEERS, at 6—(in the rooms of the Geological Society, Burlington House, Piccadilly, W.1). Inaugural meeting. A. M. A. Struben: Presidential Address.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Lieut.-Col. E. R. L. Peake: "The Rhodesia–Congo Boundary".

Wednesday, February 7

EAST LONDON COLLEGE, at 5.30.—Prof. F. E. Fritsch: "Certain Aspects of Algal Biology" (Four succeeding lectures).*

ROYAL SOCIETY OF ARTS, at 8.—Robert R. Hyde: "The Human Element in Industry".

Friday, February 9

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. Herbert Freundlich: "Some Aspects of Colloid Science" (succeeding lectures on February 16, 23, March 9 and 16).

ROYAL ASTRONOMICAL SOCIETY, at 5.—Annual General Meeting. Prof. F. J. M. Stratton: "International Co-operation in Astronomy—a Chapter in Astronomical History" (Presidential Address).

ROYAL INSTITUTION, at 9.—Sir J. J. Thomson: "Reminiscences of Physics and Physicists".

Official Publications Received

GREAT BRITAIN AND IRELAND

Lecture on Alchemists in Art and Literature. By Richard B. Pilcher. Pp. 54. (London: Institute of Chemistry.)

British Industries Fair, 1934, Olympia and White City, London, February 19th to March 2nd. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+544+Ads. xii+Ads. 184. (London: Department of Overseas Trade.) 1*s*.

Proceedings of the Royal Society of Edinburgh. Vol. 53, Part 4, No. 23: The Mathematical Representation of the Energy Levels of the Secondary Spectrum of Hydrogen. By Dr. Ian Sandeman. Pp. 347–353. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 9*d*.

OTHER COUNTRIES

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 468–477: On the Sorption of Hydrogen by Reduced Nickel, 1: Determination of the Quantities of Hydrogen adsorbed by and diffused in Pure and Spoiled Reduced Nickel, and Determination of the Isothermal Adsorption Lines and the Heat of Adsorption, by Shun-ichiro Iijima; Studies on Dietary Requirements for Lactation, 1: Failure of Lactation on an apparently complete Synthetic Diet, by Waro Nakahara and Fumito Inukai; Growth of Transplanted Tumors in Albino Rats maintained on a Diet with Protein Hydrolysates as substitute for Protein, by Umetaro Suzuki, Waro Nakahara, Nabetaro Hashimoto and Ryosuke Ikeda; The Influence of Alcohol on the Growth of Transplanted Tumors in Rats, by Umetaro Suzuki, Waro Nakahara, Nabetaro Hashimoto and Ryosuke Ikeda; The Constitution of Resorcine and Acetylacetone viewed from the Raman Effect, by Taro Hayashi; Studies on Thermo-luminescence Spectra of Fluorites, Part 2: Division of the Bands in Thermo-luminescence Spectrum of Fluorite into Two Groups, by Eiichi Iwase; On the Sorption of Hydrogen by Reduced Nickel, 2: Adsorption of Hydrogen by Reduced Nickel at Low Temperatures, by Shun-ichiro Iijima; Über die Konstitution der Glucoside, Mitteilung 7: Das Glucosid von *Sanguisorba officinalis*, von Shigehiro Abe und Munio Kotake; On the Surface Free Energy of Liquids and Liquid Mixtures, by Yonezō Morino; Resistance of Impact on Water Surface, Part 4: Circular Plane, by Shumpei Watanabe. Pp. 285–307+vi+1–135+18 plates. 1.25 yen. No. 478: La likva fazo de portlandcemento je praktika mikspropordo. De Tutomu Maeda kaj Ryōzô Syōzi. Pp. 137–152. 20 sen. (Tokyo: Iwanami Shoten.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 98: On the Transmissibility of the Visible Light through a Cloud of Particles, Part 3: Scattering of Light from Particles. By Daizo Nukiyama. Pp. 61–100. 30 sen. No. 99: Investigations on the Origin of the Sounds emitted by Revolving Airscrews, 1: Measurement of Pressure-Variations in the Neighbourhood of the Airscrew Blade. By Jûichi Obata, Sakae Morita and Yahei Yosida. Pp. 101–114. 15 sen. (Tôkyô: Koseikai Publishing House.)

Mémoires de Musée Royal d'Histoire Naturelle de Belgique. Mémoire No. 53: Monographie de la Faune malacologique du Bruxellien des Environs de Bruxelles. Par Dr. Maxime Glibert. Pp. 215+11 plates. Mémoire No. 54: Étude de la variation dans la composition de la florule du toit des veines de l'Olive et du Parc des Charbonnages de Mariemont-Bascoup. Par A. Rousseau. Pp. 30+2 plates. Mémoire No. 55: Le genre alveolites Lamarck dans le dévonien moyen et supérieure de l'Ardenne. Par M. Lecompte. Pp. 50+4 plates. (Bruxelles.)

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